THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LIII. No. 1354.] LONDON, APRIL 23, 1889. [41ST YEAR. Price 6d.

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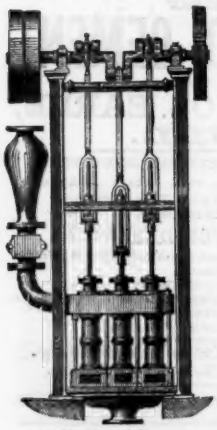

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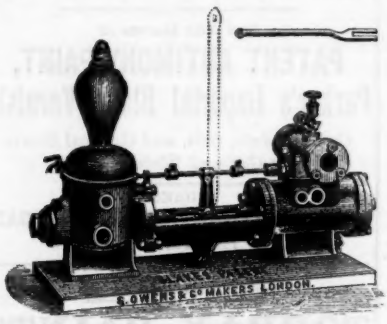

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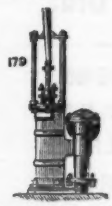

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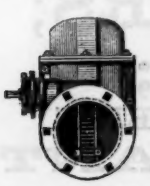

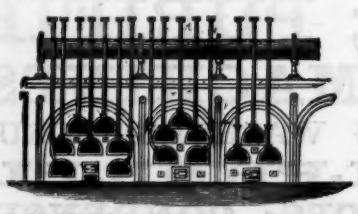

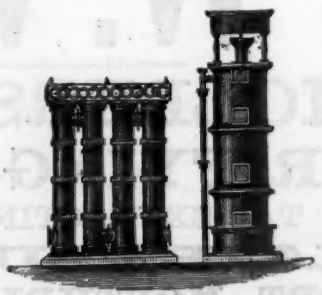

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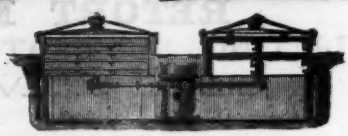

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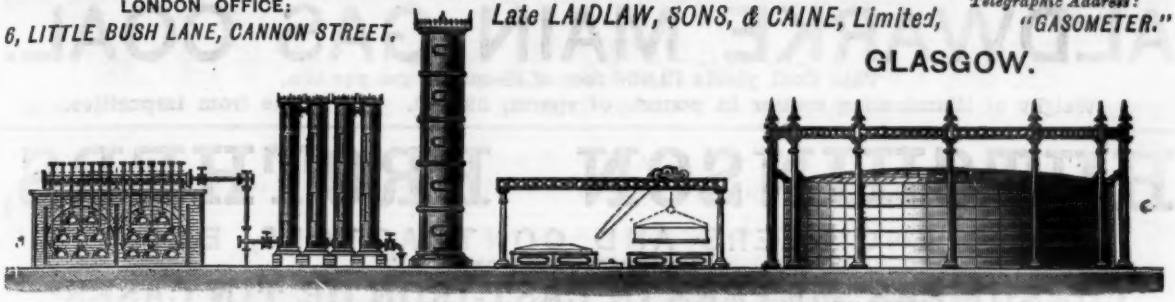

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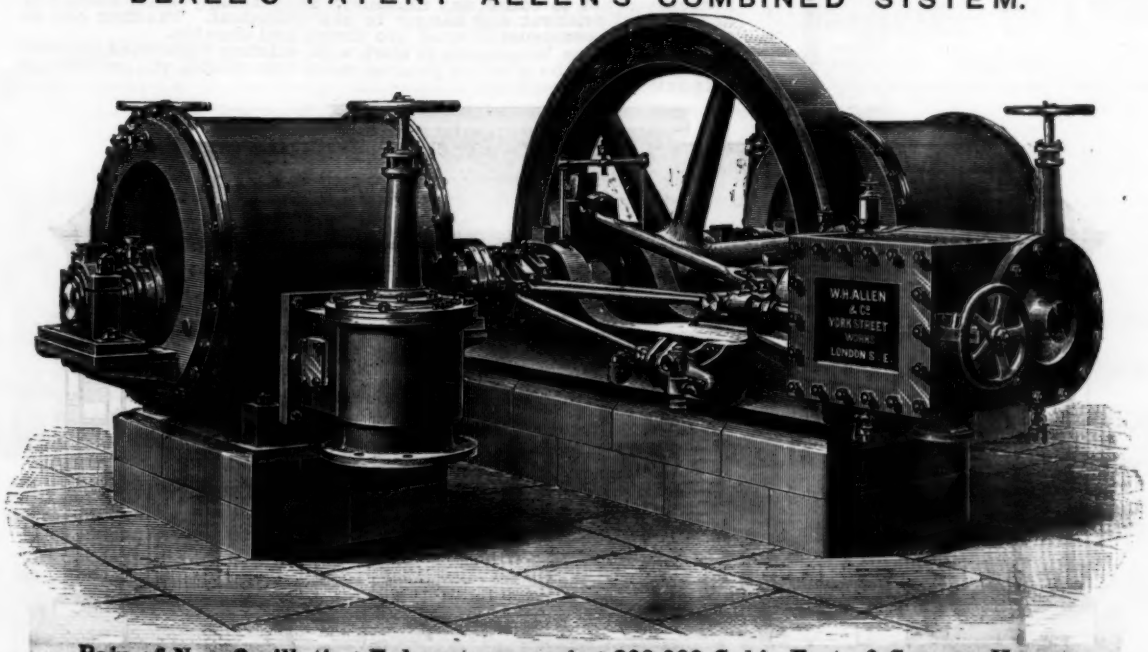

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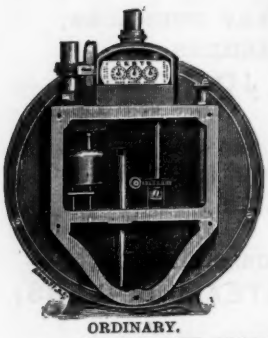
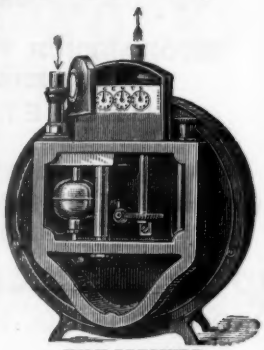


ORDINARY.



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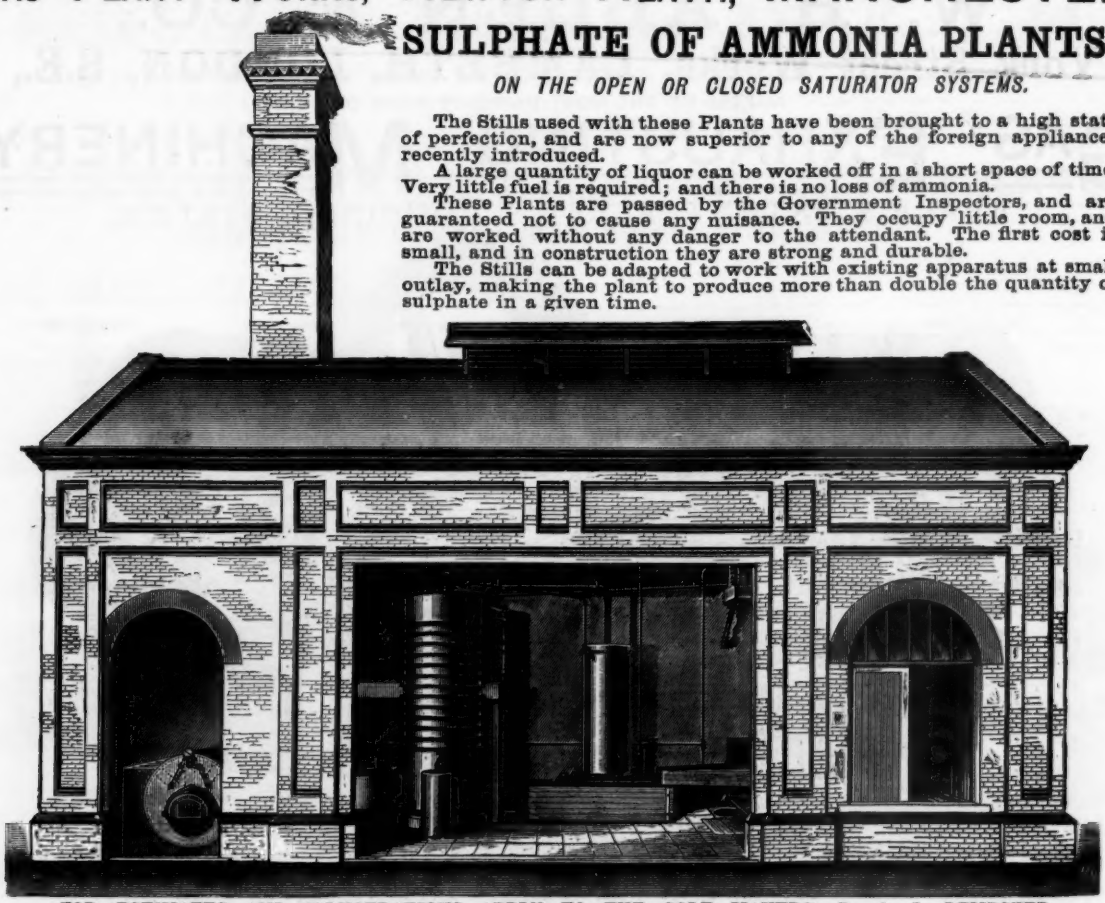

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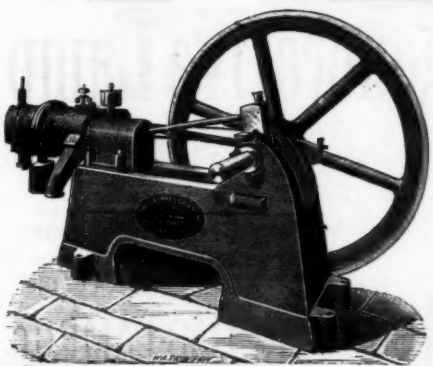

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Testimonial from Mr. JAMES MOON, Engineer to the Filey Gas-Works.

GENTLEMEN,—We have been using one of your Gas-Engines on our Works for about four months, and I have pleasure in saying that it does its work in a very satisfactory manner. The engine is half-horse power, steady in all its movements, and, with ordinary care, will drive the exhaust apparatus at an even gauge.—I remain, Yours respectfully,

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Price Lists, Specifications, and Estimates provided for any work appertaining to Gas Lighting, from the Retort-House to the Drawing-Room.

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G. R. HISLOP'S PATENT REGENERATIVE PROCESS

MOST EFFECTIVELY AND *ECONOMICALLY RESTORES* LIME WASTES CONTINUOUSLY.

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Further particulars may be had on application to A. F. WILSON, Esq., Assoc. M. Inst. C.E., 12, Walbrook, London, E.C., Agent for London; J. E. FISHER, Esq., Stourbridge, Agent for the rest of England, Wales, and Ireland; or to the Patentee—

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MANUFACTURERS OF WROUGHT-IRON TUBES AND FITTINGS, BRASS GAS-FITTINGS, GAS-VALVES, STEAM AND WATER VALVES, &c.,

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BLAST-FURNACE BRICKS.

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The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

A PURE WHITE & PERFECTLY STEADY LIGHT,

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Suitable for any existing fittings (Brackets or Suspending).

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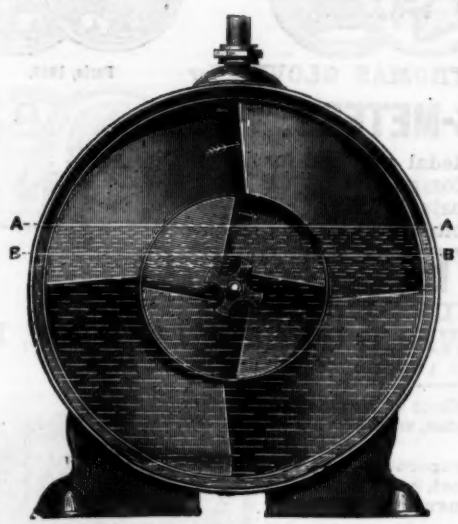
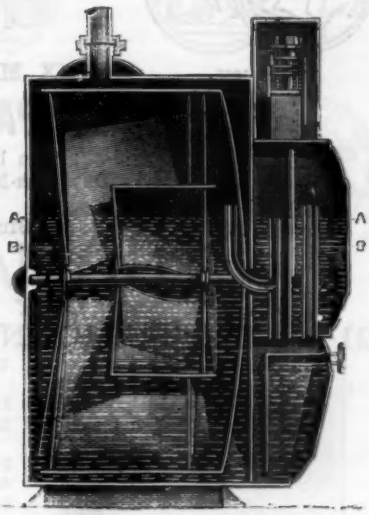
THE WARNER AND COWAN METER.



Drum in Case. Hollow Cover removed.



Sectional Side View of Meter.

Elevation showing Tin Case Meter.

Elevation showing Cast-Iron Case Meter.

In its completeness as a measure, the WARNER AND COWAN drum differs from every other. Of definite capacity, irrespective of the water-line, it can neither be over nor under filled, but discharges at each revolution the same volume of gas.

It is to this also that its secondary, though important, advantage is due—viz., the long float-range which this drum permits.

The illustrations show front and side views of the drum, and also views of the complete meter—both in tin and cast-iron case.

The drum being of fixed capacity within itself, the extraneous mechanism and arrangements are of the most simple character. These include all that is necessary, but exclude all that would be superfluous.

W. & B. COWAN,

ESTABLISHED 1827

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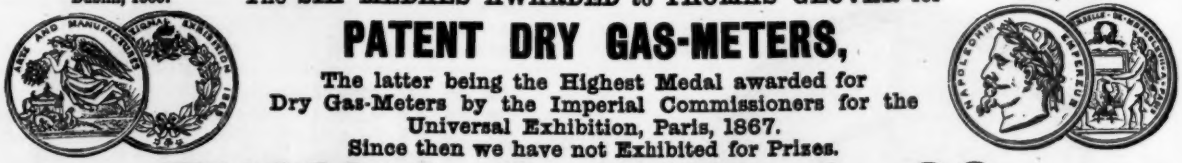
Established 1844.] **ORIGINAL MAKERS.** [Established 1844.

London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865. Paris, 1867.



The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.
Since then we have not Exhibited for Prizes.

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214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

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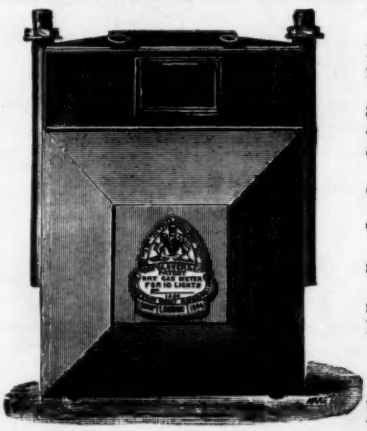

1st—Are a remedy for all the defects of Wet Meters
2nd—Are suitable for all climates, whether hot or cold.
3rd—Incur no loss of Gas by Evaporation.
4th—Cannot become fixed by frost, however severe.
5th—Are the most accurate & unvarying measurers of Gas.
6th—Prevent jumping or unexpected extinction of the Lights.
7th—May be fixed either above or below the level of the Lights.
8th—Cannot be tampered with without visibly damaging the outer case.
9th—Will last much longer than Wet Meters.
10th—Will not cost more than one-half for repair that Wet or Water Meters do.
Are upheld for five years without charge.

Meters fitted with Grey's Index or Harding's Counter.

W. PARKINSON & Co.,

COTTAGE LANE WORKS, CITY ROAD, LONDON.

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NEW DESIGN STATION METER (No. 2 PATTERN).

W. PARKINSON & CO. have introduced the above design of Station Meter in order to meet the demand for a more ornamental Tank. It is simpler in construction than No. 1 Pattern, and consequently less in cost. All joints are planed, the most modern improvements introduced, and the entire Meter is of the strongest and most substantial description.

FITTED WITH

PARKINSON'S PATENT THREE-PARTITION MEASURING DRUM.

MATERIALS and WORKMANSHIP of the VERY BEST QUALITY ONLY. PRICES, &c., ON APPLICATION.

Highest Award, Melbourne Exhibition.

[See also Advt., p. 768.

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, APRIL 23, 1889.

THE PROVISION OF GAS-FITTINGS BY THE RAMSGATE CORPORATION.

In another column will be found a report of an interesting discussion recently held in the Ramsgate Town Council, resulting in the adoption of Mr. W. A. Valon's scheme for increasing the consumption of gas, which has already been explained to readers of the JOURNAL by the author, and has been discussed in these pages. It is a coincidence that now we are publishing the intelligence of the formal adoption of this scheme, we should in the same issue give a letter from Mr. H. Edwards, of Shanghai, referring to our first comments upon Mr. Valon's proposals, and claiming the priority which we were disposed to allot to Mr. Valon. We fear we must plead guilty to not having been instructed in the practice of the Shanghai Gas Company; but now that we know what Mr. Edwards has done in this matter, we congratulate him upon his spirited policy and its results. If we had been aware of this, however, it would not have made any material difference in our remarks upon Mr. Valon's project; because we had only British statutory gas undertakings in mind when those remarks were written, and the circumstances of these are so essentially different from those of any foreign or colonial gas company, that it is impossible to embrace them in the same purview. It is to be presumed, for instance, that the Shanghai Gas Company are not compelled to supply any householder within their district with gas on demand, as are the Ramsgate Corporation. It is possible that this difference may not really amount to much in the end; but it is a sufficient distinction, on the face of it, to induce an observer to pause before agreeing that a policy suitable for one undertaking would necessarily suit the other. People look at this obligation to open accounts with all comers from different standpoints. Some gas managers may be disposed to rejoice in the opportunity; declaring their willingness to do business with anybody who shall have sufficiently satisfied the landlord of his respectability as to have obtained possession of a house. Others may feel the obligation as onerous, and consider that their duty to their employers requires them to surround the opening of a new account with all the safeguards provided by the law. The matter is made more serious by the addition of a provision of gas-fittings to the supply of gas. It is risky enough, it may be said, to supply a total stranger in the town with gas for over four months before there is a chance of seeing the colour of his money; but if to the rental is to be added the charge for fittings—or rather the expense of these to the Gas Company—a timid manager might think it safer not to run the extra risk for the mere prospect of an increase of business.

To return to the doings of the Ramsgate Town Council. The matter came up for discussion on the recommendation of the Gas Committee, which was "that a trial be made of "fitting, at the expense of the Gas Department, houses at "a rental not exceeding £30 per annum with supply-pipes, "meter, plain brackets, burners, and boiling-ring." This, which may be styled the fundamental proposition, was qualified and explained by a series of supplementary recommendations, which served, among other purposes, to introduce a prepayment meter. Mr. Valon has invented a meter of this class which, not in his own opinion only, fulfils all practical requirements better than any other of the same order that has yet been put upon the market. We say nothing about this, for time, which tries all things, will settle the question, whether we offer an opinion or not. All that need be said on this part of the subject is that Mr. Valon should know what is wanted in a meter; and he has probably not brought this piece of apparatus forward without well satisfying himself that it is likely to answer in the extensive experiment now inaugurated by his Corporation. The appearance on the scene of this prepayment meter has made a great difference in the aspect of the whole scheme; removing, in fact, the element of risk which it originally contained. As now settled by the Corporation, the use of the prepayment meter is compulsory. The ordinary price of gas in Ramsgate is at the present moment 3s. 2d. per 1000 cubic feet; but Mr. Valon has evidently taken to heart what has repeatedly been argued in these columns on the subject of the forbiddingly large unit of quantity by which gas is sold in the United Kingdom, and for his special class of new consumers has decided to adopt the "centner" instead of the "millier" as the unit of sale and purchase. The price of gas per millier working out in this case to a fraction under 4d. per centner, and it being desired to make the new departure pay for itself, the charge has been fixed at 4½d. per centner, which is an advance of 7d. per millier on the rate paid by consumers on the quarterly scale who provide their own fittings, and only require the visit of the collector at comparatively long intervals. The data upon which these rates were fixed may be gathered from the report. Mr. Valon estimates on a consumption of 10,000 cubic feet of gas per annum for every house; the average cost of fitting being taken at £4. Not much fault can be found with either of these figures. They mean, therefore, that the consumer so supplied will pay, in advance, 5s. 10d. per annum—or (say) 6s. in round figures—out of which the Corporation must recoup themselves for his extra cost to them as compared with a consumer of the older class. If the capital sunk in providing these fittings, sinking fund included, cost the Corporation 5 per cent., it would be repaid and leave 2s. towards working

expenses, comprising the cost of inspecting, collecting, &c. If 200 houses are dealt with in this way, it would hardly pay under this head, without taking into account the profit to be derived from the increased sale of gas. This must in fairness be done, however. Not having Mr. Valon's figures, with the exception of those given in his letter which appeared in the JOURNAL for Jan. 15 last, we cannot say exactly how he works out the profit. The proposal he then made differs somewhat from the scheme as adopted, to the benefit of the consumer; for whereas he then contemplated a charge of 10 per cent. per annum on the cost of the fittings supplied, the actual charge is only 7½ per cent., as shown above. The latter scheme is to be preferred. Matters are greatly simplified by the prepayment meter, which was not mentioned in Mr. Valon's letter; and it is to be hoped that the Corporation, the consumers, and the Engineer will reap the full benefit from this praiseworthy piece of enterprise. Mr. Valon is to be congratulated on the unanimous support which he received from the Town Council; and the latter are to be felicitated on their possession of an Engineer so well qualified and disposed to give them and the public the best results from the working of the undertaking confided to his care.

The progress of this Ramsgate scheme will be carefully scrutinized from far and near. As we have taken occasion to remark, Ramsgate is perhaps peculiarly situated, as an ancient town and a pleasure resort, for the trial of an experiment of this character. Its example may be available for other places of a similar order; but perhaps not for manufacturing towns. The new consumers sought in Ramsgate are not cottagers; and Mr. Valon's aim is not specially that of popularizing gas among "the people," to use the ordinary acceptation of this elastic term. If he succeeds in getting his first list of 200 prepayment consumers on the books, it will mean that the cheap and ubiquitous petroleum lamp depends for popularity—in Ramsgate, at least—less on its intrinsic value than upon its convenience in connection with the finances of the user. If it is cheap, it is also troublesome; and people will pay for ease and the saving of time. The issue is very plainly joined in this instance. As a matter of expense there is very little to choose, probably, between petroleum at 8d. per gallon, and gas at 3s. 9d. per 1000 cubic feet—or, as it may get to be known in Ramsgate, 4½ per centner. (It is we who suggest the terms "centner" and "millier" in connection with this discussion, not Mr. Valon, to whom they may or may not recommend themselves. Perhaps, if electrical supply ever comes to the fore in the town, the facility of the comparison between the Board of Trade unit of electricity and the centner of gas may lead to the familiar conversational use of the latter.) A duplex lamp, giving about the same light as an ordinary 5 cubic feet flat-flame burner with Ramsgate gas, will burn a pint of oil in a night, costing a penny; and the gas-burner supplied through the prepayment meter will burn about a pennyworth of gas for an equal time of lighting. At the year's end there might be a shilling or two of difference between the two methods of lighting; but not more, if fair account is taken of everything. As, however, a question of double or treble cost does not deter a wealthy householder from indulging a fancy for electric lighting in preference to gas, for which there is very little foundation outside of fashion, so it may be expected that people will prefer gas to lamp oil whenever the two are offered on anything like equal terms. Gas is better than oil; this is the long and short of the argument. If it had been otherwise, the years that have passed since the introduction of cheap mineral oils would have witnessed the decadence of the gas industry, instead of its greatest development. A public-spirited Municipality having the control of gas supply cannot, therefore, better justify the pleas by which it assumed this duty, than by rendering gas more easily available by the mass of the population. If local authorities owning gas undertakings did not so commonly forget their duties in thinking of their profits, we should now have less occasion to single out Ramsgate as an example of a town where an energetic Engineer finds countenance and support in his efforts to improve and popularize the service with which he is identified.

THE LIGHTING OF THE STREETS OF THE CITY OF LONDON.

THE Annual Report of the Engineer and Surveyor to the Commissioners of Sewers of the City of London (Colonel Haywood) has been issued; and an abstract of it will be found in another column. It records that the price of gas supplied for the public lamps by The Gaslight and Coke Company has been reduced to 2s. 2d. per 1000 cubic feet; the number of lighting hours being taken at 4300 per annum. The report shows how the cost of the ordinary street lamp burning 5 cubic feet per hour has been steadily falling since 1870. It does not look well for the City lighting authorities that, although many other local highway authorities within the Metropolitan area have during the past year shown a tendency to rise above the thraldom of custom, and light their streets with better lamps and more powerful burners, the Commissioners of Sewers have not yet made any alteration in this respect. Although the public can now obtain a very much better service of street lighting at no more expense per lamp than was borne by the highway authorities in 1870, the City appears to adhere to the old 5 cubic feet burner, as though some law prevented all improvement. The report makes due acknowledgment of the enterprise of The Gaslight and Coke Company in illustrating how street lighting may be improved; but the remarkable thing is that all this instruction goes for nothing with the Commissioners, who seem far more disposed to contemplate spending twice the money for unreliable electric lamps than would provide the streets with the best lighting by gas. Nobody can accuse the Commission of undue haste in making up their minds in regard to street lighting matters. For, although they seem to look favourably upon electricity, they do nothing to obtain it; and it is a curious commentary on the alleged improved condition of the electric lighting interest that, during the past year, not one street in the City of London was lit by means of electric lamps. Oil-lamps have had a trial on the Holborn Viaduct, where Edison incandescent electric lamps were first displayed to a curious, but not altogether admiring public. This reads like a retrograde step; but that is a consideration that the oil-lamp and electric lighting interests may be left to argue out between themselves. Nothing succeeds like success; and if the oil stays where electricity could not be maintained, the last laugh, which is proverbially the loudest, will be for the oil-lamp makers. The history of the past year's street lighting in the City is not eventful, and the report upon it cannot be made very striking. Such as it is, however, the interest of gas supply need not be ashamed to refer to it.

THE DISPUTE BETWEEN THE DUBLIN CORPORATION AND THE GAS COMPANY.

THEY manage gas matters strangely in Dublin. This is a reflection that must have occurred to many readers of our periodical comments upon the developments of the feud between the Corporation and the Gas Company; but it receives extraordinary emphasis from recent proceedings between the parties in the Irish Exchequer Divisional Court. The account rendered for gas supplied to the public lamps is in dispute between the parties. That is a matter of course, which hardly needs to be stated. In the present instance the bill was for £6800; being the account for three quarters' rental. The Corporation paid £5000 on account, without prejudice to their denial of liability for the rest, raising the plea that the matters in dispute between them and the Company should be referred to arbitration. These matters, as stated before the Court, comprise alleged deficiencies of illuminating power, not keeping the lamps in proper order, the omission of proper facilities for testing the gas, and several other contentious points. The chief of these, however, is the first named, for all the rest are of minor importance. In effect, the Corporation claim the right to have the account for gas supplied to the public lamps corrected by an allowance computed with regard to deficiencies of illuminating power; the same to be ascertained by an arbitrator. It will be remembered that the Corporation some time ago declined to accept the tests of illuminating power of the gas made by the Official Examiner, and had tests made by their own Inspector of Public Lighting, who purported to show deficiencies rendering the Company liable to fines amounting to £350. They refused the challenge of the Gas Company to bring this matter to the proof in the manner provided by the Act, on the remarkable plea that the procedure and tribunal appointed to this effect were not satisfactory. They wanted the question of defective illuminating power to be referred to arbitration. Now, the Act of 1871, section 27, directs that "any difference which may arise between the undertakers "and any local authority in relation to *the supply or consump-*"*tion of gas* to or by such local authority shall be from time "to time settled by arbitration." This is the section the Corporation rely upon in the present case. As, however, there is nothing said therein about the quality of the gas, the

testing and penalties for default in which are dealt with by other sections, it is difficult to see why the latter should be ignored. The case is not yet settled; and it is impossible to foresee what may be held with regard to this particular plea in the suit. It is, notwithstanding, quite open for us to remark that the Corporation have to show why, if they have not elected to proceed against the Company in the regular way, and recovered the penalties provided in case of proved deficiencies of illuminating power in the gas supplied for the public lamps, they should be entitled to bring the matter forward as a set-off against their account. Even if the fines had been recovered, nobody ever heard of a reduction of the gas account elsewhere in consequence of such proceedings. The Metropolitan Gas Companies have all been repeatedly fined for defective illuminating power; but this has never interfered with the collection of their rightful charges for gas supplied. If this principle is admitted in the case of a local authority, why should it not hold good for every private consumer? We look forward with some curiosity to the decision of the Irish Court on this point.

THE TREATMENT OF GAS CONSUMERS BY LOCAL AUTHORITIES.

Notable examples of the treatment of gas consumers by local authorities are supplied by recent doings in connection with the gas supplies of Salford and Stafford. At the former place, as reported a fortnight ago, a sum of £41,354, admitted to have been unnecessarily placed to the credit of the gas-works depreciation fund, was given bodily to the ratepayers, who never paid a penny towards it, while the consumers were propitiated by a reduction of 4d. per 1000 cubic feet in the price of gas. These Corporations owning gas-works play with sums of tens of thousands of pounds made out of gas consumers as though they were the merest trifles, Everybody is considered to have a claim upon the gas profits before the unfortunates whose excessive payments create them. In the Stafford case, consideration of which arises out of the recent Local Government Board inquiry (reported elsewhere) into the positions of loans of the borough, the gas undertaking has been treated as a milch-cow for the Municipality, and, as a natural consequence, gas is dearer in Stafford to-day than it would have been if the supply had remained in the hands of a Company. The gas profits are drawn upon here as elsewhere to make good losses in other Corporation departments; the capital charge of the undertaking is reduced with unnecessary speed; and all comes upon the gas consumer, who has lost the protector he had in the Corporation when the works belonged to the Company. Then the Local Authority was all for cheap gas and an improved supply; but when possession of the works has once been secured on this plea, the consumer is placed in bondage to the ratepayer, from which there is none to deliver him. Sulphur impurities suddenly cease to trouble, and the photometer has a long rest. Money is all that the new administration care for; and if the deluded consumer who pays for all can be cozened into believing that when he pays an exorbitant shilling for his gas, he gets relief to the extent of twopence in the shape of rates not so high as they would otherwise be, he is happy.

A CORRECTION OF A FALSE REPORT.

The newspapers last week published more or less sensational descriptions of a destructive fire which occurred last Saturday week at the warehouse of Mr. J. Hodgson, envelope manufacturer, of Little Trinity Lane, City; and most of them gave great prominence to the statement that the fire originated in the bursting of a gas-bag attached to the gas-engine which supplied motive power for the machinery on the premises. If this report had been true, it would, of course, have been a serious matter, for the reputation of this class of motors for perfect safety would have been gravely affected. We therefore took occasion last week, in recording the circumstance of the fire (which was undoubtedly due to a gas explosion), to mention that this statement was without foundation; a visit of inspection paid to the premises by a representative of the makers of the engine in question—Messrs. Crossley Bros., Limited—having revealed the reassuring fact that not only the incriminated gas-bag, but also all the other fittings of the engine, remained perfectly intact after the fire. It is advisable, however, to state that the official report of the fire, drawn up by Captain Shaw, does not make any reference to the gas-engine, but gives the origin as an "explosion of gas." Some newspapers have inserted this correction; but in a much less prominent place than their first misleading report. We have judged it expedient, therefore, in view of the great interest at stake, to give the correct version of the affair in the most conspicuous manner. It is naturally difficult for ordinary reporters of such occurrences to ascertain the rights of a disaster of the kind; but incalculable mischief may be done by the dissemination of such an error. Gas explosions will happen where gas-engines are used as well as where they are absent, while human carelessness co-operates with material defects in fittings by which gas is introduced for any purpose into an enclosed space. That the risk of such occurrences is increased to any recognizable extent by the use of a well-fitted, well-constructed gas-engine is, however, a conclusion that nobody has yet seen any valid reason for accepting; and no such opinion can be supported from the circumstances of the fire at Mr. Hodgson's factory.

Death of Mr. R. Johnston.—We regret to announce the death, on the 14th inst., in Manchester, after only a week's illness, of Mr. Robert Johnston, the representative of Messrs. W. and B. Cowan.

Death of Mr. E. M. Jones.—We regret to record the death, last Wednesday morning, of Mr. Edwin Myddleton Jones, Manager of the Holyhead Gas-Works. Mr. Jones was an old servant of the Holyhead Gas Company, having held the position of Manager for thirteen years.

Electric Lighting in the Inner Temple.—The elaborate preparations which were commenced some time back for the purpose of illuminating the chambers and offices in the Inner Temple with the electric light have now been definitely abandoned; and the extensive excavations, &c., made in the Inner Temple Gardens for the reception of the necessary plant and machinery are now being filled in, and the gardens will shortly resume their usual appearance.

North of England Gas Managers' Association.—We have received from the Honorary Secretary of this Association (Mr. W. Hardie) the circular for the forthcoming half-yearly meeting, which will be held at the Offices of the Newcastle-on-Tyne and Gateshead Gas Company on Saturday next, under the presidency of Mr. T. Bower, of West Hartlepool. The business will include the reading of a paper entitled "A New Departure in Tank Building," by Mr. V. Wyatt; and an explanation, by Mr. G. Pettigrew, of Gateshead, of his dovetailed spigot and socket pipe-joint, which he will exhibit. After the meeting, the members will, as usual, dine together at the County Hotel.

Conviction of W. G. Watson for Stealing Parcels.—Last Tuesday, at the London County Sessions (Southern Division), William G. Watson, described as an agent, was sentenced to 20 months' imprisonment for stealing a large number of articles from the Waterloo Station of the South-Western Railway. Prisoner was formerly in the employ of Messrs. W. and B. Cowan, as a traveller, at a salary of £400 per annum, but had lost his appointment through intemperate habits. Going from bad to worse, he finally started last August as a railway thief, and carried on his depredations till he was arrested early last month. He was identified as having committed robberies at the Euston Station; but these cases were dropped.

The Water Gas Enterprise in England.—The *Financial News* says: "The British Water Gas Company has received invitations from local authorities and large manufacturers to form sub-companies. Arrangements are being made to comply with them, and whenever a sub-company has been organized it has met with very strong local support. That for Yorkshire is already flooded with orders for plant, as well as with proposals for district rights. A sum of £30,000 has, for instance, been offered for the town of Sheffield. The Lancashire Company, which is likely to be next brought out, has been entirely underwritten in Manchester, and will have a picked Board of Lancashire capitalists, including Sir Joseph Lee, the Chairman of the Manchester Ship Canal. A joint Company has been formed for Nottingham and Derby; another for Stafford and Lincolnshire; and a third for Northampton and Leicestershire. In every case the capital is assured, and the profit to the parent Company will exceed three times the purchase-money it paid for the patents."

A New Lignite Industry.—Attempts to utilize lignite in the production of illuminating gas have been frequently made, but with only partial success. Its use as fuel has hitherto been much restricted, also on account of its weakness as a combustible. Yet there are large deposits of lignite, or brown coal, in different parts of the world, waiting to be utilized when a general advance in the price of coal directs attention to cheaper (if poorer) fuels. Recently a trade in compressed lignite has been started in Germany, with encouraging results. Lignite is easily formed into solid briquettes, as it contains a proportion of resinous matter which cements the pulverulent constituents of the mass when strongly compressed. As mined, the lignite is pasty, containing some foreign matters and a great proportion of water. It is accordingly screened, reduced to powder, and dried in air ovens. The compressed lignite competes with coke for use in domestic stoves, as it sells locally in Germany for about 7s. 6d. per ton. The centres of the lignite briquette industry at present are Kalscheuren and Heizengorath, near Aix la Chapelle.

Water and Sanitary Affairs.

The London County Council, on the recommendation of their Parliamentary Committee, have resolved to take the necessary steps for introducing a Bill into Parliament enabling the Council to deal with the question of the water supply. The Committee have submitted a draft of the Bill, the clauses of which confer power on the Council to introduce Bills into Parliament in reference to the supply, and also authorize the Council to defray the expenses of making and carrying on inquiries relative to this subject. The Special Committee on Water Supply appointed a short time back, presented a report at the last meeting of the Council, stating that the first step necessary to enable them to deal with this matter would be the institution of an inquiry as to the whole question of the water supply of London. At present the Council have no power to defray the expense of such an inquiry. It is curious that, while the consideration of the report of the Special Committee was ordered to stand over until after Easter, as an opposed report, the Council adopted the report of the Parliamentary Committee, which really gives form and substance to the aspirations of the Special Committee. So the matter stands at this hour, so far as the County Council are concerned. But fresh impetus is likely to be given to this question by a report which Captain Shaw has presented to the Fire Brigade Committee. This report advises a great extension of the Brigade, in respect to men, buildings, and appliances. Among other things, the water supply is touched upon as being "distinctly a part of the "general subject of protection from fire." But Captain Shaw considers that "years must elapse" before any very extensive change is made in the conditions under which the mains are charged; and he suggests that in the meantime the Council should make the best use they can of the means already at their disposal. One more incident transpiring last week concerning the water supply is furnished by the Commissioners of Sewers, who have grown weary of waiting for the completion of their artesian well, and have resolved to put an end to the present contract; fresh tenders being invited. More than two years have passed away since this enterprise was resolved upon; and the actual operations have been going on for the greater part of that period, with the result that the well is not yet down to half its proposed depth. It is said the contractors have experienced unusual difficulties; chiefly owing to the presence of sand. But, making all due allowance, it is thought that the work ought to have gone on much faster, and hence the decision to place the contract in other hands.

The artesian well of the Commissioners of Sewers is a small matter compared with the action of the County Council. Yet the two are links in the same chain. It may also be found, as we have just intimated, that Captain Shaw's report to the Fire Brigade Committee will have peculiar influence in bringing the water question to the front. *The Times* had a leading article discussing the report; declaring that the question of the water supply "really lies at the "root of all reform of our fire arrangements." For this and other reasons, we are told, "it is becoming a matter of "urgency to deal with the water supply of the Metropolis." The predictions of General Scott, in the last annual report of the Local Government Board, are adverted to; and the remark is made that "the enormous growth of the population "at once calls for greatly increased supplies, and adds to "the difficulty of obtaining them from the accustomed "sources." Finally, the County Council are urged to give immediate and careful attention to "the adjustment of "the innumerable questions which will have to be settled "before the water supply of the Metropolis can be put "upon a satisfactory basis." One question, probably not present to the mind of the writer in *The Times*, appears to us to be this: Whether the best use has up to now been made of the Water Companies? The prevailing attitude of the Metropolitan Board towards the Companies was one of antagonism. In the matter of the constant supply, the Board gave no assistance or encouragement, but rather the reverse; declaring their dissatisfaction with the conditions under which the supply was given, at the same time leaving the Companies at liberty to introduce the constant service where they pleased. It is now complained by Captain Shaw that, whereas there are 3170 miles of water-pipes in London, only 1182 miles of these pipes are constantly charged with water under pressure. So far as the action of the Metropolitan Board was concerned, there need not have been a single mile of main under constant pressure. In the City, the Corporation have provided, at their own cost, a complete system of hydrants; yet even there we see a distinct refusal to take any active steps for introducing the constant supply into the houses. The artesian well is simply an attempt to coerce the New River Company into an abatement of price. Neither has Parliament dealt fairly by the Water Companies. When the Grand Junction Company proposed to enlarge their resources by tapping the underground waters above the present sources of supply on the Thames, it was objected in the House of Commons that this was only another form of taking water from the river; and the Bill was rejected without the grace of an inquiry. The attitude of the County Council is now the next question. If that body will adopt the reasonable course of opening communications with the Water Companies, it may come to pass that a large amount of public money will be saved; and a settlement of the water question be accomplished at a much earlier date than would otherwise be possible.

The debentures issued by Water Companies are a favourite form of security. Any decision which defines the rights of debenture-holders will, therefore, be of interest to a very large class of investors. In this connection it may be useful to draw attention to the recent action against the Herts and Essex Water-Works Company, Limited, in which the plaintiffs, suing on behalf of themselves and all other debenture-holders interested in the undertaking, sought to enforce their security. Unfortunately, both the principal and the interest secured by these debentures were in arrear; and Justice Kay was called upon to decide in what manner the plaintiffs were entitled to assert their claims. For the Company it was contended that the debenture debt could only be recovered from the tolls and receipts which accrued from time to time in respect of the undertaking, and that it was not open to the debenture-holders to seize and sell the property itself; thereby putting an end to the Company's operations, which, of course, were carried on in some measure for the public benefit. The main point was whether a decision given some years ago with respect to the effect of debentures issued by a Railway Company could be made applicable to Companies formed for the purpose of supplying the public with water. By virtue of the older case (in which the London, Chatham, and Dover Railway Company were the defendants) it has long been recognized as sound law that a mortgage debenture made by a Railway Company in the form given in Schedule C of the Companies Clauses Consolidation Act, 1845, does not give the debenture-holder a specific charge upon the surplus lands of the Company or on the amount which may be realized by the selling of such lands. The "undertaking" of a Railway Company which is pledged by such a mortgage is the going concern created by the Act; and this cannot be broken up or interfered with by the holder of a mortgage debenture. The earnings of a Railway Company may, however, be made available to satisfy the claim under such a security. Justice Kay now holds that the same ruling applies to the case of a Water Company; and, following the decision in the railway case, his Lordship has declared that the plaintiffs in the action against the Herts and Essex Company are entitled to a charge upon the undertaking and to the appointment of a receiver. The learned Judge, however, felt himself bound to refuse to appoint a manager, or to direct the sale or foreclosure for which the plaintiffs applied.

An artesian well district of a remarkable character was described in a recent number of the *Scientific American*. Some wells are mentioned which throw a constant supply under a natural pressure of from 100 to 200 lbs. per square inch. The district is the James River Valley, Dakota, and is an immense flat 300 miles in length, bounded by distant mountains; the Rockies probably being the source of these remarkable high-pressure supplies.

By the will of Mr. Lewis Thompson, whose death, at the age of 78, was announced in the JOURNAL for the 5th ult., a sum of £15,000 is bequeathed to his Executor (Mr. C. D. Andrews, of Leominster), for investment in Government stock, the interest on which is to be paid over to the Guardians of the Poor of Byker (the township of Newcastle-upon-Tyne in which the deceased was born), and applied by them in relief of the poor-rate. The investment is to be known as "Thomas Thompson's Poor-Rate Gift;" and the only conditions on which the income arising therefrom is to be used by the Guardians for the above-named purpose are that they shall, on the 17th of August in each year, place a "memorial garland, of the value of not less than two shillings, on the tomb of the testator's father in Jesmond Cemetery, and keep and maintain the tomb in a substantial state of repair. If the Guardians fail to comply with these conditions for three successive years, the £15,000 is to pass unconditionally to the nation.

Essays, Commentaries, and Reviews.

THE AFFAIRS OF THE GAS INSTITUTE.

In last week's article commenting upon the affairs of The Gas Institute, we made a statement, on the authority of Mr. W. Longworth, the Hon. Sec. *pro tem.*, referring to the change of the place and time of the next meeting. We also stated that the proposed visit of the Institute to Paris was "understood" to be abandoned. Although the manner in which the sentence in question is framed should render the explanation unnecessary, we have been desired to point out that the latter of the two statements was not made on Mr. Longworth's authority. As a matter of fact, we repeated it from common rumour, or "understanding," which this time appears to have been incorrect, or at least premature.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 778.)

During the past week business on the Stock Exchange naturally dwindled down a good deal, owing to the incidence of Jewish close-days and the approach of Christian holidays. Markets, however, for the most part ruled fairly firm; and though there was a tendency to droop a little on Wednesday, a better feeling was re-established the next day. This was aided by the reduction in the Bank rate from 3 per cent. (at which it had stood since Jan. 31) to 2½ per cent.; and the fine weather had a brightening influence. The Gas Market has been quieter, and presents but few noteworthy features. The tone of some stock has been just a shade less firm, owing perhaps to restricted business; but there has been no fall in prices—the few changes in quotation which have been made being, on the contrary, in the upward direction. The bulk of the business has been in Gaslight "A," which was very brisk on Monday, and was more or less dealt in during the rest of the week. The best price was 264; and the lowest, 261. The debenture and preference issues were quite neglected; but one or two transactions were effected in the "H" 7 per cent. maximum. This issue always commands a better proportionate price than some of the preferences; being the second largest of the Company's issues. South Metropolitans have hardly been touched; a single transaction in the "B," at 245, being really the only business recorded. Nothing at all has been marked in Commercials, though we heard of a fair quantity of old stock changing hands at better than average figures. In Suburbans and Provincials, the only feature is a rise of 2 in Brentford, both old and new. Now and then a transaction is marked in the 5 per cent. preference of this Company, though it is not regularly quoted; and it commands about the same price as the similar stock of Gaslight and Coke does. Among the Foreigners, Imperial Continental has been steadily dealt in at very good figures—good enough to warrant the quotation being moved up. A few transactions in Continental Union and Monte Video, at middle prices, comprise the rest of the business. Water has been almost stagnant; but Southwark ordinary rose 1.

The daily operations were: Monday's Gas business was mostly in Gaslight "A," at average figures. Imperial Continental changed hands at top prices. In Water, East London and Lambeth were done once each at a low price. All quotations remained unchanged. On Tuesday, Gas was rather quieter, and without special feature. In Water, the only business was in Southwark ordinary, which rose 1. On Wednesday, the volume of Gas business was much diminished; but Brentford old and new advanced 2 each. Water was untouched. On Thursday, business in Gas was mostly in Gaslight "A," at very moderate figures; and nothing moved. Water was again quite neglected, and all quotations remained unchanged.

ELECTRIC LIGHTING MEMORANDA.

THE BOARD OF TRADE INQUIRY—ELECTRIC LIGHTING AT THE PARIS EXHIBITION—A CONGRESS OF ELECTRICIANS.

The Board of Trade Inquiry into the proposed schemes for lighting London by electricity is progressing, though not very rapidly. There is a crowd of witnesses to be examined, and it is difficult to forecast the result of the inquiry, seeing that so many great authorities on the subject of electric lighting are engaged in it for the purpose of contradicting each other. It is like a game in which every player in turn tries to "cry over" his opponents. It would not be a matter for wonder if the Inspector were to confess in the end that every little shred of knowledge concerning electric lighting with which he began his investigations had been sworn away by the witnesses. One of the most interesting of these was the inevitable Mr. W. H. Preece, who appeared in his capacity of Consulting Electrician to the London Commissioners of Sewers. He gave some striking statistics relating to the lighting of the City by gas and electricity. The number of gas-burners estimated by him as being in daily use in the city of London—which occupies a square mile of ground—is 622,000; which may be taken as the greatest numbers of such lights ever reckoned as concentrated within so limited an area. In the same space there are 3136 public lamps, which cost the City £10,350 per annum. It is very peculiar lighting, however, seeing that most of the private lights are out by seven o'clock at latest; which means that for six months in the year the majority of the burners are not lit at all. Mr. Preece estimates that 500 arc and 1000 incandescent lamps would replace the gas-lamps in the city streets. We draw the attention of the Editor of our contemporary the *Electrical Review* to this particular portion of Mr. Preece's evidence, as proving—what has been denied in this publication—that Mr. Preece still clings to incandescent lamps for street lighting, notwithstanding that they have been discredited of late in so many places. Proceeding to deal with the private lighting, Mr. Preece estimated that one-third of the existing number of gas-burners might be replaced by incandescent electric lamps, which would give to any electric lighting company that might secure the district a handsome subscription list of 210,000 lamps. It is remarkable that, although Mr. Preece could quote the experience of the New York Edison Company when it suited his purpose, he altogether ignored the fact that the record of the extent to which this Company's operations have interfered with the business of the New York Gas Companies does not bear out his idea that an electric light company in London could take away a third of the Gas Company's customers. Proceeding from estimates to criticism of the schemes laid before the Inspector, Mr. Preece corroborated all we have said from time to time about the Deptford project of the London Electric Supply Corporation; and most emphatically pronounced it "a gigantic experiment." If Mr. Preece's testimony is good for anything at all, he has condemned this scheme root and branch. He declared that the Company's operations on the scale proposed would upset every telephone in London; and he evidently also thought the telegraphs would suffer. Altogether, it is plain, amid much confusion, that the electric lighting interest will have no easy task to settle the preliminaries for entering into their imagined inheritance of 210,000 lamps in the City of London.

From particulars which have already appeared in the Journal, our readers will have learnt that the electric lighting of the Paris Exhibition will be a big job. The great machinery hall, which is the largest building on the ground, is to be made brilliant with what may be described as sun-lights of arc lamps—ceiling clusters arranged somewhat on the pattern of gas sun-burners—in addition to pendant lamps. In the original Government scheme of the exhibition there was no formal arrangement for meeting the expenses of the lighting; but the responsibility has been taken by a Syndicate of electrician-exhibitors. An English firm—the Crompton Company—take the principal share in this work; and the Woodhouse and Rawson Company also have a good deal to do. The central garden will be lighted by the Edison Company. Although several French electric lighting firms participate in this effort, it does not appear, on the face of the programme, as though it will be worth while for anybody to visit the exhibition for the sake of seeing the electrical effects, which will for the main part be due to firms who have shown their powers in England on various occasions. The garden lighting and luminous fountains, for example, concerning which our French contemporaries are exciting themselves in advance, are evidently to be modelled upon our own past South Kensington displays. Having advantages in their site, and also in the scale of their operations, it will be their own fault if the Frenchmen do not improve somewhat upon the late Sir Francis Bolton's ideas in this respect. The provision of motive power for all the electricity that is to be used on the Champ de Mars during the coming summer is naturally a serious undertaking. Here again our old acquaintance, Davey, Paxman, and Co.—of "Glocester," as the French compositors have it, being their nearest possible approximate to Colchester—are to the fore. There are, of course, other engineers in this enterprise; but the Davey-Paxman engines will be difficult to beat. From the number of English names connected with the lighting of the exhibition, it would not be surprising if the general result should be something after the style of a South Kensington on the Seine.

Among the other electrical attractions at the Paris Exhibition will be an International Congress of Electricians to be held at the end of August, according to the terms of a recently issued Ministerial decree. This special document refers with evident pride to the first International Congress of Electricians, which met in Paris, under the auspices of the French Government, in 1881, and had for its object the definition and nomenclature of the units of electrical measurement. One consequence of this congress—the adoption of the Violle platinum standard of light—has not received the endorsement of practical usage; but this is a comparatively small blemish on the reputation of the distinguished personages who took part in the proceedings. The programme suggested for the contemplated assembly is not so ambitious as that which was dealt with in 1881. It nevertheless comprises several matters of great interest not merely to professional electricians, but also to the community at large; and it is quite possible that the transactions of the congress may be useful in advancing the cause of electrical distribution. Among other subjects proposed to be dealt with by the assembled *savants* is the question of meters for electrical currents, which is one of the most important points connected with the commercial development of electrical supply. The comparative advantages and drawbacks of alternating and battery transformers will also be discussed, as also the multiplicity of considerations arising out of the handling of the strong currents required for the most economical systems of distribution. Telegraphy, telephony, and the employment of electricity in medicine are highly important and interesting divisions of the general subject; and all these matters, and more, will doubtless be well discussed by the congress. The assembled electricians will, in short, have plenty of work to do if they concentrate their wisdom on only a tithe of the difficulties awaiting magisterial treatment in the science with which they are identified. The idea of holding such a conference is a natural outcome of the high place given to electricity in the scheme of the exhibition; and it is to be hoped that the result will be commensurate with the intentions of the French Government.

THE NATURE OF LUMINOUS FLAME.

THE paper on "Flame," by Mr. F. J. Rowan, the first part of which is given in another column, is a very interesting *résumé* of what has been written on this subject since Sir Humphry Davy published the first scientific statements respecting the cause of the luminosity of flames. It is eminently desirable that reviews of this character should appear from time to time, in order that students may see how their traditional conceptions of the cause and nature of phenomena bear the brunt of modern investigation. While only the shallowest minds permit themselves to sneer at an old explanation, merely because it is old, the wisest admit that very few, if any, of the hypotheses which men recognize as laws of nature are superior to correction. So when the fathers of modern science gave reasons for the most striking of the natural phenomena which remained unexplained in any rational fashion up to their day, they inaugurated a variety of traditions, some of which are altogether respectable to the present time, some remain doubtful, and others have been exploded by later research. The pioneers of exact knowledge, beginning with Galileo, were sometimes right and sometimes wrong in the explanations they offered of natural phenomena—or rather, perhaps, it would be better to put it that some of their explanations hold good to the present day, while others have been set aside as less satisfactory than others since made. The examples of Newton's theory of gravity, and his crepuscular theory of light, are illustrations of both observations. To come directly to the subject of flame, the accepted theory of the cause of the luminosity of flames was enunciated, as has already been said, by Sir Humphry Davy. It is that the light is due to the incandescence of solid particles of matter in the hot but non-luminous gases which compose the body of the flame. This hypothesis is held to be proved by the fact that flames of pure gas, such as hydrogen, are not luminous and do not contain any solid particles, but can be made so by the addition of such particles, as in the lime light. Moreover, the existence of solid although invisible particles in the luminous flames of coal gas, lamp oils, and candles is triumphantly demonstrated by plunging into them a cold metal or glass rod, and withdrawing it coated with soot, which is thereupon supposed to have existed in the same state in the flame. As Mr. Rowan points out, Dr. Frankland and others have made experiments which show that the luminosity of flames admits of another explanation than that of the presence of solid particles; and it by no means follows that because lampblack is deposited upon a cold surface enveloped in, or apparently touched by, the flame, therefore the same substance exists in the flame in a like state. We know, as a matter of fact (thanks mainly to the observations of Mr. Frederick Siemens), that no foreign body can be introduced into a live flame without gravely interfering with its normal *régime*. The cold surface robs the nearest portions of the flame of the heat necessary to maintain the process of combustion—in short, puts that part of it out. The combustion being hindered, down comes the carbon, precipitated, as it may be said, by the introduction of the cold substance. If the solid carbon is present in the flame, there is no reason why it should not be likewise found present in the gas before ignition. If it can be precipitated on a cold rod plunged into a gas-flame, why can it not be arrested by some means in the pipes through which the gas has to pass? Conversely, if the luminosity of a gas-flame is due only to its richness in soot particles, why cannot a poorly luminous flame be rendered bright by the introduction of soot into it at the point of combustion? Indeed, gas-burners have been made with this object, consisting of a reservoir of lampblack through which the gas was forced to pass on its way to the open air, where it was ignited. The construction of such burners was a logical consequence of the acceptance of the doctrine that the luminosity of a gas-flame depends upon its richness in solid particles of carbon. If this is the source of light, then the more carbon the higher the brilliancy. Only in practice the result was disappointing. The finely powdered lampblack remained in its receptacle unaltered in weight by the passage of any quantity of gas, and the illuminating power of the burner was absolutely unaffected by the presence of the supposed enricher. The effect of a mechanical admixture of solid carbon particles in the gas-flame could certainly be observed when the impatient consumer, irritated at being deceived by a "burner quack," jarred the fixture with his fist. The consequence of this proceeding was to fill the flame with lurid sparks, as of burning dust; while if the action was continued, the floor and other surfaces under, and in the immediate vicinity of, the "improved" burner soon betrayed the fact that lampblack can pass through a gas-flame unconsumed.

It has been argued that the truth of the popular conception of the cause of the luminosity of a gas-flame is supported by the evidence of the Bunsen, or atmospheric burner, when by the admixture of air with the gas, luminosity is removed. As a matter of fact, however, the Bunsen flame, if it proves anything at all, supports the opposite theory; for if it is the presence of solid particles of carbon that causes luminosity, what becomes of them in the atmospheric burner? Adding air to the gas does not remove the carbon or anything else that it may have previously contained; and if these, by their incandescence, cause the light in the white flame, why do they not show the same effect in the atmospheric flame? Mr. Rowan scarcely mentions this variety of flame in his paper; but its importance in the arts should forbid us to overlook it. What, then, is the reason for the non-luminosity of the atmospheric gas-flame? We do not know, but imagine that the intimate association of the combustible with the oxygen of the air interferes with the operations that go on when luminous hydrocarbons and hydrogen burn, as in a white flame, with air only in contact with the surfaces of the flame. There the hydrogen appears to burn first, and raises the hydrocarbons to such a temperature that their subsequent ignition upon contact with the atmosphere is attended with a further development of temperature and bright light. The temperature of the luminous shell which constitutes the white portion of a luminous flame is higher than that of any portion of a Bunsen flame; and it seems probable that the brilliant light may be due to the surface compression, if we may so express it, of the hydrocarbon gases there undergoing violent combination with the oxygen of the air.

To intensify the activity of surface combustion would therefore appear to be the key to the production of brilliancy of flame. The suggestion is made with all diffidence; but it is supported by a good deal of evidence contained in Mr. Rowan's paper. Thus, to feed a flame with oxygen instead of air is to heighten its brilliancy, because, we will say, the action at the point of contact is rendered more violent, as the shell of the flame is the only part where it can take place. On the other hand, mixing oxygen with coal gas, as in the oxy-coal-gas blowpipe, renders the combination facile throughout the body of the flame. This would imply that the surface of an oxygen-fed coal-gas flame is much hotter than the blowpipe flame; and there is no evidence to the contrary. The heat of the blowpipe flame may be more available for external work than that of the very thin luminous shell of the white flame; but this does not affect the point. Surface combustion of coal gas may be intensified not only by substituting oxygen for air, but also with air, by applying a blast to the surface of the flame, as in modern Argand burners, or by heating the air and gas, as in a recuperative burner. Or, in addition, there is the effect of compression cited by Mr. Rowan; and the removal of aqueous vapour, which tends to lower the temperature, as suggested by Mr. Methven. We arrive at the conclusion, therefore, from this brief examination of the subject, that there may be scope for considerable further improvement of the illuminating power of coal-gas flames by working in the direction herein indicated—namely, *the intensification of combustion on the surface.*

We get rid of the erroneous idea that the luminosity of flames is due to the incandescence of solid particles through reasoning on the single example of Frankland's experiment, in which pure hydrogen or carbonic oxide is shown to burn with a brilliant light in compressed oxygen. Arguing from this datum, we may say that the hydrocarbons of coal gas combine with sufficient energy with the oxygen of common air, under certain conditions, to produce the same effect. The hypothesis of the presence of free carbon in the flame is thus superfluous. Having placed the matter upon its proper basis—having found for the phenomenon an intelligible explanation—the path of practical application defines itself. How far or in what manner it may be best followed, is not for us to declare. It is enough to know that a right theory, deduced, it may be, from experimental data not directly growing out of any hypothesis, is the best guide to further progress in experiment. Practice goes first; then comes observation, reasoning, and theorizing. Very often the theorizing goes astray upon some plausible but misleading indication, such as that of the existence of solid carbon in gas-flames, and the effect of directing a non-luminous blowpipe flame upon a piece of lime. When the true theory is found, however, it always points the way to developments which could not have grown out of the false hypothesis, although some may have been hit upon empirically.

THE RELATION OF WATER SUPPLY AND DISEASE.

IN the last article of this series (*ante*, p. 571), we pointed out the inadequacy of the grounds upon which Dr. Robson Roose had consoled his readers in regard to the pollution of the Thames by sewage. The question is one upon which doctors will always differ. This was strikingly shown in the evidence laid before Parliament in the case of the Stockton-on-Tees and Middlesbrough Water Bill in 1876. One chemical witness considered that sewage meeting 500 times its bulk of water would be innocuous; another held that one part of sewage in 1000 parts of water would be harmless; and a third (Dr. C. Meymott Tidy) suggested that one part of sewage in 20 parts of water, with a run of 20 miles, could not produce any ill effects.

The position of affairs at Stockton-on-Tees, which led to the memorable contest above mentioned, is, in this connection, worth recalling. In regard to the water drawn from the Tees, there was just the same sort of difference of opinion as that which prevails to-day or may be manifested to-morrow, with respect to the water of the Thames. There were people at Stockton who condemned the Tees water out and out; others were milder in the terms of their disapproval; and some did not seem to think there was anything at all to complain of. That the river was contaminated by sewage nobody could deny. A population then numbering about 12,000 persons made use of the Tees as a common sewer. The bulk of these people were inhabitants of Barnard Castle—a town situate about 17 miles above the intake of the then existing Water Company at Stockton. In Barnard Castle there were eight miles of sewers and a number of privies, 50 of which actually overhung the stream. There were, besides, some smaller places which contributed their quota to the pollution of the river. Upon these incontrovertible facts, the scientific witnesses examined on behalf of the Corporations of Stockton and Middlesbrough founded their opinion that it was inexpedient that the Tees should be resorted to for a supply of water for dietetic

purposes. It was not suggested that the health of Stockton was below the average, any more than it is now urged that the health of London is, for the moment, largely affected by the present contamination of the Thames. The real ground of apprehension lies in what *may* happen, and is only too likely to happen, through the medium of such contamination. Assume an outbreak of epidemic disease in a town which drains into a river, and it at once becomes more than probable that the epidemic will reach those who, living it may be at a considerable distance from the seat of the original outbreak, have to take their water supply from the same contaminated stream.

This was the theory which was put forward, and not successfully controverted, in the Stockton case. It was urged that in the event of an outbreak of cholera at Barnard Castle, there would be great danger of the river becoming the carrier of the germ or poison to the inhabitants of Stockton. The old argument, recently trotted out once more by Dr. Robson Roose, was, of course, set against this contention. It was said that, granting that Barnard Castle poisoned the Tees, the river itself provided an antidote. The Tees received the sewage 17 miles above the Company's intake; and between the outfall sewer of Barnard Castle and the intake, the water was tumbled about over a gravelly bed and aërated as it flowed, so as to become quite innocuous before it reached the Company's works. There was a rejoinder to this reply. Those who supported the case of the two Corporations argued that the flow of 17 miles would have no effect in rendering the sewage harmless, and, indeed, that the very rapidity of the river would carry the excreta all the more rapidly to the intake at Stockton. This view of the facts was strongly supported by the conclusion arrived at by the Rivers Pollution Commission of 1868, which has already been adverted to in these articles. It is true that Dr. Frankland's analyses of Tees water had not revealed anything injurious; but against this circumstance must be set the fact that some epidemics are propagated by a specific poison which is not, as yet, discoverable by chemical analysis. Nevertheless it may be present; and, being in a vital condition, is not amenable to oxidation. If this is to be accepted as a correct view, it follows that the mere negative results of chemical analysis do not demonstrate the non-existence of such germs. The fact is that, though such analysis can do much, there is still a great deal that it fails to accomplish. The outcome of the evidence taken in regard to the Tees was that the chemists could not distinguish sewage which would, from sewage which would not cause disease. How far the Committee gave weight to the evidence of the experts who were called for the Corporations it is, of course, impossible to say; but it cannot be doubted that the indisputable facts as to the contamination of the river must have had some considerable influence upon their judgment.

All this, as we have already suggested, is worth remembering, because in some respects the story of the pollution of the Thames is the old story of the pollution of the Tees "writ large." If and when the effect of the pollution of the Thames is fully and fairly considered in connection with the great question of London Water Supply, we shall again be met with the same controversy, the same stock arguments, and the same old conflict between scientific witnesses. But, in the meantime, it is right that it should be made clear that, whatever may be the facts as to the contamination of the river, no blame can be justly attributed to the Metropolitan Water Companies for a state of things which they unanimously deprecate, and have done their best to guard against.

The Directors of the Imperial Continental Gas Association recommend a dividend of 5 per cent. for the second half of 1888.

In the course of an interesting report just presented to the London County Council by Captain Shaw, the chief of the London Fire Brigade, on the protection of London by fire, he refers to the arrangements for ensuring a supply of water, and says that when it is remembered that there are at present 3170 miles of water-pipes in London, and that of these only about 1182 miles are constantly charged with water under pressure, it will be seen that, for the present and for a long time to come, all the arrangements will be based on the existing condition of things in this way, as, even under the most favourable circumstances, years must elapse before any very extensive change could be made in the water supply, while in the meantime the Metropolis has to be protected.

At a recent meeting of the Institution of Civil Engineers, Dr. C. E. Emery read a paper on the "Distribution of Steam in the United States." The author had designed and constructed the steam plant of the New York Steam Company, who have in use a length of about 5 miles of main steam-pipes, much of which is 15 and 16 inches in diameter. The steam is distributed at the high pressure of 80 lbs. per square inch from a station in which the boilers were arranged in four stories at the sides of central fire-rooms. The plant was designed for boilers of 16,000-horse power; 12,000-horse power being in position. The pipes, in lengths of about 16 feet, were generally provided with flanges, whereby they were readily lowered into and adjusted in the trenches. A duplicate system of pipes for return water was laid on the same trench with the steam-pipes. The largest volume of steam is consumed during ordinary business hours; but there is an appreciable use in newspaper offices, eating-houses, and for some manufacturing operations, during the night. The consumption in summer for power is about half that during the winter. The consumers are charged from 80c. to 70c. per 1000 "kals" (1 kal = 1 lb. of water evaporated into steam), according to the quantity used.

Notes.

Gas Heating for Steam Cylinders.

An interesting experiment now being tried by Messrs. Bryan Donkin and Co. is in connection with the use of gas heating for the cylinders of steam-engines. When steam is admitted into a motor cylinder in the ordinary way, a portion of it is immediately condensed into water, to be re-evaporated during the periods of expansion and exhaust, if the cylinder walls are hot enough. Messrs. Donkin have a model engine in which the actions here described may be watched, the cylinder being of glass lined with a metal tube which can be either cooled by a current of water or heated by a gas-jet. The temperature of the cylinder is shown by a thermometer placed in a cup of mercury in contact with the surface under observation. The cylinder walls may thus be kept at any desired temperature above or below that of the exhaust. When the cylinder is cooled below the exhaust temperature, the condensation is made visible in the form of drops which do not evaporate during exhaust. As the temperature is raised, the drops of water become smaller, and disappear during exhaust. Finally, the cylinder may be so heated that no condensation visible to the eye can be seen at any part of the stroke.

A Coke Furnace.

The use of coke as fuel for steam-boilers, which is general in the majority of gas-works in the United Kingdom, and in many other factories in British towns, appears to be a novelty in some parts of the Continent. At least, this is the only interpretation we can find for the proclamations that occasionally signalize attempts in this direction, as they are recorded in Continental technical journals. Perhaps this difference of practice may be traced to the divergency of the types of boilers favoured in this country and abroad. The ordinary tubular boiler, so generally in use in England, with the furnace enclosed in the water space, may lend itself better to a non-flaming fuel than the plain cylindrical boilers with exterior fires principally used abroad. However this may be, on the occasion of the establishment of a third boiler in the Municipal Gas-Works of Mannheim a new departure, signaled in the *Journal für Gasbeleuchtung*, was made in the direction of adapting it to burn coke. This boiler was in the form of three cylinders united by water legs, and wholly enclosed in a brick casing. The furnace was made deep, to accommodate a thick fire, and the iron plating of the boiler over the fire was protected by a tier of fire-tiles, to prevent the direct contact of the gases of combustion with the metal. This had the effect of improving the combustion, by rendering the mixture of the carbonic oxide with the air more complete. The fire-bars are of plate iron, 8 inches thick, spaced an equal distance apart, and riveted together in threes. The fire and ash-pan doors shut air-tight. The air required for combustion is admitted by a channel opening at the back of the boiler setting, and comes to the front in a cast-iron pipe built underneath the bottom flue, where it gets heated to 100° C. by the waste gases. It rises in channels formed behind the front wall, and enters the ash-pit under the bars through openings in the side walls. A secondary supply of air at a higher level is brought in the same way from front to back, becoming heated by contact with the upper smoke flues, and meets the combustion gases just before the partition corresponding to the bridge in an ordinary furnace, at which point it has a temperature of 300° C. The ash-pan is kept full of water, and a steam jet is employed to keep clinkers from adhering to the fire-bars. Breeze is burnt in this furnace. The duty obtained is 9·65 of water per unit of fuel, which contains 10 per cent. of ashes and clinkers.

The Prevention of Slipping in Belts.

The slipping of leather belts is an annoyance well known to power users, who are occasionally driven to cure it temporarily by the use of resin. A German journal, in an article on the subject, remarks that in such a case, if the belt cannot be tightened by shortening, it must be thoroughly lubricated. Resin is entirely unsuitable for increasing adhesion, as all substances of this class are injurious to the leather. They are bad if used only as a makeshift, for which alone they are sometimes excused, as they render the leather hard and brittle. The pulleys become dirty and uneven by the resin, which adheres to them in lumps, and these stretch the belt unequally. It is advisable to wash the belts from time to time with warm water and to brush them, after which they must be lubricated on both sides with a mixture of equal parts of tallow and train oil. If lubrication is required without throwing off the belt, only the outer side must be treated. The lubricant should be used at a temperature of 113° to 122° Fahr. If the belts are not lubricated at certain regular intervals, they lose their elasticity, become brittle, and unsuitable for work. If a belt has been allowed to become very hard and dry, the lubricating mixture should be changed to one-third tallow and two-thirds train oil, to be applied after the belt has been moistened. If the belt is required to work in a damp locality, it must be rubbed with bees-wax after lubricating. Belt users are specially cautioned against lubricants containing vaseline, petroleum, or other mineral-oil preparations, as these are not suitable to be put on leather.

Concrete and Iron-Trellis Construction.

A method of constructing tanks, walls, floors, &c., in cement with a framework of iron rods, has been described before the Société des Ingénieurs Civils, by M. Cottanein. The idea is to start with a bottom curb of any convenient section of wrought iron

from which springs a lattice-work of iron bars of any section—preerably round rods on account of their good quality; the points of ntersection being connected by any simple means of attachment such as wiring, which does not require much labour. In this way a strong structure may be built up with great economy of material, and all risk of cracking avoided. The almost identical co-efficients of expansion of the iron and cement, render the permanence of the tructure under ordinary variations of temperature all that can be desired. It has been used for service reservoirs for water; walls of 4 metres high only requiring a thickness of 10 centimetres at the base, even when fully exposed to sun and frost. Drain conduits are also made in the same way, 4 or 5 centimetres thick. These pipes stand well whether exposed or buried, and can be built to any desired profile. One advantage of these tubes is that they retain a certain degree of elasticity, and do not therefore break in case of ordinary settlements of the subsoil. The possibility of making easy connections with this method of construction, suggests its use in gas-works for purifiers, gasholder tanks, and tanks for chemicals. It is regarded by M. Cottanein as much cheaper than rendered masonry construction, and at the same time more reliable than simple concrete. M. Cottanein has employed it in the construction of two covered circular tanks, 11 metres in diameter and 3 metres deep.

The Manufacture of Large Steel Tubes.

As an example of the manner in which mechanical progress develops in unexpected directions, it is reported that an improved method of constructing heavy fly-wheels, devised by Herr Mannesmann, of Remscheid, Westphalia, will probably have great influence upon the manufacture of steel gas, water, and steam tubes. It is known that the work stored up in a fly-wheel is proportional to the mass and the square of the velocity of its rim. Up to the present time it has not been the practice to carry this velocity beyond 40 metres per second, for fear of causing the rupture of the wheel, ordinarily constructed of cast iron. Herr Mannesmann has had the idea of employing a fly-wheel with steel arms and with a rim built up of steel wire wound a great number of times upon itself, and by reason of the tenacity of the wire he has been able to run wheels so constructed at a speed of 120 metres, or triple the ordinary velocity. The effect of this improvement is to store up, for the same weight of material, a quantity of work nine times greater than usual, without increasing the risk of rupture. Consequently, as adopted for rolling mills, machinery thus equipped renders possible the treatment of steel ingots of previously impossible weights, whereby tubes of all diameters up to 10 metres long may be made with ease. These tubes are of beautiful finish and easily withstand a pressure of 100 atmospheres. The cost, moreover, is not more than that of cast-iron pipes of scarcely one-tenth the strength.

Communicated Article.

THE CHEMISTRY OF ILLUMINATING GAS.

By Norton H. Humphrys, Assoc. M. Inst. C.E., F.C.S.

XVI.

In an article published in 1879, entitled "Water Gas: its History and Manufacture," Professor Henry Morton gives the following analyses as fair examples of a large number of tests made on the gas supplied by the Municipal Gas Company, of New York, who use the Tessié du Motay process, in which water gas is carburetted by being passed through petroleum, and then caused to circulate in very hot retorts, in order to decompose the vapours into permanent gas*:—

	Municipal Gas.			Lowe Gas.
	June, 1877.	Dec., 1877.	—	
Hydrogen	27·29	27·897	23·487	34·548
Marsh gas	25·43	21·646	24·622	21·699
Illuminants	15·12	17·262	17·363	12·828
Paraffins	1·14	0·702	—	0·869
Carbonic oxide	26·18	26·790	27·893	25·233
Carbonic acid	0·21	0·371	0·371	3·402
Nitrogen	4·45	4·243	5·235	1·408
Oxygen	0·14	0·600	1·021	trace.
	99·96	99·511	99·992	99·987

In the third analyses the "paraffins" were not determined, but reckoned in with the marsh gas and hydrogen. It appears that they are identical with the "benzols" of the Paris Gas Company and other investigators, and consist of vapours condensed out of the gas by cold or pressure, in addition to the illuminants absorbed by bromine or other reagent. Professor Morton prefers to call them "paraffins," in order to avoid confusion with the impure naphthas known by the trade terms of benzole or benzene.

The analysis marked "Lowe" is prepared by a different process, so called after its originator. The apparatus consists of a generator and a superheater, and represents the form generally used for the manufacture of water gas in America. The cupola is charged with anthracite or other carbonaceous fuel, which is raised to incandescence by means of an air-blast. When the right temperature is obtained, the air is shut off, and steam is blown in at the bottom of the cupola; while at the same time a regulated supply of petroleum or other suitable enriching material is admitted at the top. The steam ascends up through the fuel, and water gas is formed; consisting chiefly of hydrogen and carbonic oxide. The gas meets and mixes with the vapour of petroleum at the top of the cupola; and the mixture passes on to the superheater, which is composed of a fire-brick chamber packed with a cellular structure of fire-brick, and maintained at a very high temperature. Here the petroleum vapours are decomposed to a great extent. Rather more than one-fourth of the hydrogen, the whole of the marsh gas, and the illuminants are originated by the petroleum. The analyses indicate that the decomposition of the oil is carried to a greater extent in the Lowe than in the Municipal gas. It is to be regretted that Professor Morton did not also give some idea of the illuminating value of these gases.

The following table, extracted from a note attached to a paper by Dr. Armstrong,* and representing some analyses of the gas supplied in New York, as prepared by Dr. Love, the City Gas Examiner, is interesting, as affording a comparison of gases manufactured by different processes, and from various materials:—

—	Manhattan Co.	Haarlem Co.	Metropolitan Co.	New York Mutual Co.	New York Co.	Municipal Co.
Hydrogen	45·79	46·53	35·41	10·57	27·14	26·25
Marsh gas	39·01	42·38	42·66	41·75	25·35	28·91
Illuminants	6·38	6·31	7·41	15·41	14·63	15·80
Carbonic oxide	6·31	6·14	9·17	9·53	26·84	27·12
Carbonic acid	—	1·08	—	1·51	3·02	—
Nitrogen	2·51	0·50	5·35	20·69	2·87	1·92
Oxygen	—	0·06	—	0·54	0·15	—
Illuminating power	—	—	20·33	26·53	24·35	29·68

The first two on the list are evdiently good quality coal gas; the proportion of illuminants being high, and that of the diluents very low. The Metropolitan Company, it is stated, calculate on getting 70 cubic feet of 60-candle gas per gallon of oil, from which it appears that the 60-candle oil gas is prepared for the consumer by dilution with very poor coal gas, probably obtained by working very high heats. This assumption is based on the high proportion of carbonic oxide and nitrogen; 9 per cent. of carbonic oxide is high for coal gas, but not high enough to indicate the presence of any considerable proportion of water gas. The staple of the New York Mutual Company's product is evidently oil gas, as shown by the large amount of illuminants and marsh gas contained in it. This is diluted with very poor gas produced partly from wood and partly from coal. The distillation of the latter is said to be pushed to a yield of 15,000 cubic feet per ton; and perhaps this accounts for the very high proportion of nitrogen, which is over 20 per cent. The process followed by the Municipal Company has just been noticed; and the New York gas appears to be very similar in character.

A paper read by Professor W. Ivison Macadam before the Society of Chemical Industry† affords some useful information as to the quality and constitution of oil gas. A gas obtained from "twice-run crude paraffin oil" was equal to 70 candles in illuminating value, and contained 45·5 per cent. of matters condensable by bromine. No. 1 burning oil yielded a 63-candle gas of ·690 specific gravity, containing 36·8 per cent. of absorbable constituents. Gas from "crystal oil" was 54-candle power, and contained 28·5 per cent. of heavy hydrocarbons remov eable by bromine; and American petroleum yielded a 66·7-candl e gas, containing 37·5 per cent. of condensable matter. Several other samples of oil were tried, and gave gas of similar quality and properties to the above; and the average of a number of experiments conducted with the "Keith," and with the "Pintsch" apparatus, using paraffin oil as the staple material, was a 61-candle gas, of which about 39 per cent. was condensable by bromine.

The results with the Keith and Pintsch apparatus were further alluded to in a paper read at the 1887 meeting of The Gas Institute, by Dr. Stevenson Macadam.‡ In the course of the discussion that followed, Mr. Beilby referred to a report prepared by Mr. W. Foster on some samples of waste gases from oil-stills. Rich gases taken at the beginning of the distillation, were found to contain from 14·5 to 20·6 per cent. of heavy hydrocarbons; and average samples, extending over the whole period of distillation, contained from 12·12 to 13·06 per cent. The remainder of the gases appeared to be made up of substances belonging to the paraffin series—the diluents and carbonic oxide being practically absent; and free hydrogen, if present at all, was only in very small amount. It is further pointed out that the paraffin gases remaining after the removal of the heavy hydrocarbons, though largely represented by marsh gas, contain a considerable proportion of higher members of the series. For example, in one case there were 14·5 per cent. of heavy hydrocarbons present in the sample; and their carbon density was 2·9. The remaining 85·5 volumes were found to have an *average* composition of $C_{1\cdot31}H_{4\cdot52}$. Expressed as a mixture of marsh gas and the next higher paraffin (ethane C_2H_6), this constitution would correspond to 59 per cent. of marsh gas and 26·5 per cent. ethane. The illuminating power of these samples of gas was stated to be about 36 candles.

Possibly some of the foregoing results suggested an inquiry that was undertaken by Mr. M'Arthur as described in a paper read by that gentleman before the Society of Chemical Industry. He remarked that the mineral oils used for gas-making—which usually consist of burning oil of ·80 to ·81, or the cheaper inter-

* See Journal, Vol. XXXIV., p. 784.

* See Journal, Vol. XLIV., p. 808.
† *Ibid.*, Vol. XLIX., p. 856. ‡ *Ibid.*, Vol. L., p. 110.

mediate oil of ·84 to ·87 specific gravity—are a complex mixture of hydrocarbons, principally comprising members of the olefine and normal paraffin series; and that in passing through a red-hot retort, the oil readily breaks up into gas, the illuminating principles of which have been shown, by the exhaustive researches of Armstrong and Miller, to consist principally of members of the olefine, benzene, and pseudo-acetylene series, with mere traces of true paraffins or other saturated hydrocarbons. This almost complete absence of the higher paraffins from oil gas as ordinarily manufactured, led him to inquire whether oil gas produced at a lower temperature would also be destitute of paraffins, and especially whether paraffins would be found in the gas which is produced during the distillations with open steam, to which mineral oil is subjected in the ordinary course of refining. In these distillations there is always produced a considerable amount of permanent gas—frequently as much as 1 cubic foot per gallon of oil distilled; and with crude shale oil, or in the first distillation of once treated shale oil, the gas begins to be evolved when about two-thirds of the oil have distilled over. It varies in quality as the distillation proceeds; being richest at first, and gradually getting poorer, as the temperature of the still rises. Its quality is 35 candles at first; but at the end of the process, when nothing but spongy coke remains in the still, it is only of about 10 to 15 candle quality.

For the sake of comparison, some oil gas was manufactured at various temperatures, from intermediate oil of ·86 specific gravity, in a small iron retort, and furnished the results under 5, 6, and 7 in the following table. The samples of gas were treated first with bromine, and then with mineral oil of ·87 specific gravity previously heated and steamed to drive off dissolved air. For various reasons stated in the paper, this is only a rough-and-ready way of estimating the paraffins. A uniform treatment of 5 volumes of oil per 100 volumes of gas was adopted, as a larger proportion of oil would have complicated the results by dissolving a considerable amount of marsh gas. Reasons are stated for considering that free hydrogen was present in every sample; and the proportion appeared to range from 9 per cent. in No. 1 to 30 per cent. in No. 7. In the analyses by Mr. Foster above referred to, the author did not consider that the absence of free hydrogen was conclusively proved. It will be noticed that the illuminating power of Nos. 1 to 4 is comparatively low, looking at the proportion of illuminants and their high carbon density. In samples Nos. 2 and 3, the constituents absorbable by bromine appear to be present in about equal proportion to those removed by the oil.

	Low Temperature Gas from Stills.				High Temperature Oil Gas.		
	(1) Beginning of Gas Production.	(2) Middle of Gas Production.	(3) Near Coking Stage.	(4) End.	(5) Dull Red.	(6) Bright Red.	(7) Orange.
Cubic feet of gas per gallon of oil	—	—	—	—	102·3	120	158
" " ton "	—	—	—	—	26,650	31,260	42,100
Luminosity in candles	30—35	30—35	25—30	10—15	50—60	40	20—25
Specific gravity of gas, air = 1·00	1·10	1·05	0·67	—	0·69	0·56	0·50
Bromine absorption, per cent.	20	18	8	3¼	28	20	6
Carbon density of absorbed hydrocarbons	4·24	4·05	3·51	—	2·66	2·57	—
Oil absorption of residue, per cent.	—	19·40	9·00	—	2·00	2·60	0·90
Carbon density of paraffins absorbed by oil	—	4·30	3·00	—	—	—	—

Technical Record.

ON FLAME.

By F. J. Rowan, of Glasgow.

[A Paper communicated to the Glasgow and Scottish Section of the Society of Chemical Industry, and reprinted from the Society's *Journal*.]

The subject of flame possesses considerable interest from a technical point of view, because the questions connected with its nature and propagation enter into our understanding of several problems which are of first-rate importance to practical applications of science. The nature of flame and the temperature which results from its existence, bear directly upon our application of fuel and on the intensity of the heat which we produce by combustion. The velocity of ignition is a matter which in several ways is closely connected with the safe working of collieries; and recent research has shown us that the principles of gas-engine practice embrace considerations alike of the nature, temperature, and propagation of flame. In the following remarks, the author aims merely at setting forth some of the general principles of the subject, without making any specific application of them to the important problems indicated.

Nature of Flame.—What is flame? Dr. Mills has remarked that a flame may be regarded as volatile matter undergoing chemical change at a visibly red heat; and Dr. Percy, with more minuteness, says: "Ordinary flame is gas or vapour of which the *surface*, in contact with atmospheric air, is burning, with the emission of light."

These definitions leave little to be desired, as they properly direct attention to *visibility* rather than to temperature, and to the fact that the presence of combustible gas or vapour is a necessary condition to the existence of flame. We may have a solid, such as iron, magnesium, or carbon,* burning in oxygen or air, at a high temperature, with brilliant incandescence, or glowing, but without flame; whilst, on the other hand, the flame of boric methide shows that flame may exist without a high temperature. Flames are usually regarded as simple or compound, according to the number of products which result from them. Those ordinarily used in the arts and manufactures are compound flames.

From the foregoing definition of flame, it will be readily understood that all flames are more or less hollow in structure. In the centre is a space occupied by unconsumed gases; surrounding that is the luminous portion of the flame; and outside of all is the non-luminous part, or "mantle," as it is called. The unconsumed inflammable gases can be collected from the centre of the flame and afterwards ignited, and the mantle can be rendered more visible (according to Bloxam†) by burning sodium near the flame, when the mantle will acquire a strong yellow tinge.

In a blowpipe flame, the same construction is observed—the flame, however, being diminished in size and luminosity; but by mixing air with gas before ignition the three portions of a flam are reduced to two, with a considerable reduction in the luminosity of the flame. The combustion becomes complete at an earlier period; and the luminous cone has the same character as the mantle in the former case.

Temperature and Propagation of Flame.—Some interesting observations made by Deville* on the flame of carbonic oxide burned with oxygen show the chemical composition of the gases at various parts of the flame. He found that when a mixture of carbonic oxide and oxygen in the combining proportions (2 vols. of CO to 1 vol. of O) was allowed to issue, under a slight pressure, from a jet having an area of 5 square mm., a flame 70 to 100 mm. high was formed, consisting of an inner and an outer cone. The outer cone, in which combustion takes place, was deep blue at the base and yellowish or nearly colourless towards the apex. In the inner cone, which was only 10 mm. high, no combustion took place, because the rapidity of displacement of the particles of gas was there superior to the very slow rate of propagation of heat in the mixture.

To collect the gases from the different parts of the flame, a silver tube, pierced with a small aperture, was placed across it in the part to be examined, and the gases were aspirated by passing a rapid stream of water through the tube. They were thus quickly cooled, and, passing along the tube together with the water, were collected, by means of a bent delivery-tube, in jars over water.

The following table shows the results of the various observations; the first column giving the positions of the silver tube above the orifice from which the gases issued, the second column the temperatures approximately at these points, and the last division of the table the composition of the gas at the different portions of the flame:—

Height above Orifice.	Corresponding Temperatures.	Composition of the Gas.		
		CO.	O.	CO_2.
Mm.				
67	Melting-heat of silver and above	0·2	21·3	78·5
54	Melting-heat of gold	6·2	28·1	65·7
44	Commencing white heat of platinum	10·0	20·0	70·0
35	White heat of platinum	17·3	24·8	57·9
28	Strong white heat of platinum	19·4	26·5	54·1
18	Intense white heat of platinum	29 0	25·1	45·9
15	Incipient fusion of platinum	40·0	32·9	27·1
12	Melting-point of platinum	47·0	36·0	17·0
(1) 10	Sparkling of the melted platinum	55·3	35·3	9·4
(2) 10	Still higher temperature	55·1	36·5	8·4
(3) 0	.....	64·4	33·3	2·3

(1) A little above the apex of the inner cone. (2) Somewhat below the apex of the inner cone. (3) Original mixture.

These numbers show that the highest temperature is at the apex of the inner cone, or a little below it; that the temperature

* This is true of single pieces of carbon. A mass of carbon burning in air or oxygen generally shows a lambent blue flame on the surface, which is due to the burning of carbonic oxide (CO), formed by the reduction of the carbonic anhydride (CO_2) in its passage through the glowing carbon.

† "Chemistry," ed. 1867, p. 95.

* *Bull. Soc. Chim.* [2], Vol. III.; also Watts's "Dict. of Chem."

gradually diminishes towards the apex of the flame; and that the quantity of carbonic anhydride increases in the same proportion from the apex of the inner cone, where, at most, two-thirds of the carbonic oxide and oxygen enter into combination, to the vertex of the flame itself, where carbonic oxide can no longer be detected. At the apex and edges of the inner cone the carbonic oxide and oxygen unite almost instantaneously, but only partially, on account of the very high temperature there existing.* Bunsen also carefully investigated this subject, and introduced† some modifications of the views held previously. Watts ("Dict. of Chem.," I., p. 860, "Affinity") has summarized this matter as follows:—When a combustible gas mixed with oxygen is set on fire, a rise of temperature takes place, which, supposing the combustion to be perfect, may be calculated from the heat of combustion of the gases and the specific heat of the products. If, on the other hand, the combustion imperfect, the temperature may still be calculated with the aid of Mariotte's and Gay-Lussac's laws, provided the pressure exerted by the gaseous mixture when exploded in a closed vessel be known. This pressure has been determined by Bunsen for mixtures of hydrogen and carbonic oxide with oxygen, or with oxygen and nitrogen together, by means of an eudiometer having a loaded safety-valve. From this and the observed temperature of combustion, the quantity of the combustible gas (carbonic oxide or hydrogen) which has been burnt at the moment when the flame attains its maximum temperature, and thence also the quantity which at this temperature has lost its power of combining, may be calculated.

The following table contains the results of Bunsen's experiments arranged according to the maxima of temperature ($t^1 - t$) which several gaseous mixtures, calculated for volumes at 0° C., attain by combustion in a closed vessel. Columns I. and II. give the mixtures of gases used; $\frac{P}{P_o}$ = the pressure produced in atmospheres by explosion; t = the calulated temperatures; and k = the calculated proportion of combination.

Mixtures of Gases. I.	with II.	$\frac{P}{P_o}$ III.	t. IV.	k. V.	Mean.	Deviation from Mean.
			°			
½ vol. CO + ½ vol.	O	10·78	3171	0·351		+0·0194
½ „ CO + ½ „	O	11·19	2893	0·319		−0·0126
½ „ H + ½ „	O	9·97	2854	0·338		+0·0064
½ „ H + ½ „	O	9·75	2833	0·336	0·3316	+0·0044
½ „ CO + ½ „	O + 0·1079 vol. O	9·05	2558	0·314		−0·0176
½ „ CO + ½ „	O + 0·6857 „ CO	8·89	2471	0·460		−0·0421
½ „ CO + ½ „	O + 0·8854 „ O	8·44	2325	0·478		−0·0941
½ „ CO + ½ „	O + 1·0861 „ O	7·86	2117	0·490		−0·0121
½ „ CO + ½ „	O + 1·2563 „ N	7·73	2084	0·515		+0·0129
½ „ H + ½ „	O + 1·2599 „ N	7·49	2024	0·547		+0·0449
½ „ CO + ½ „	O + 1.2563 „ N	7·35	1909	0·470	0·5021	−0·0321
½ „ CO + ½ „	O + 1·7145 „ O	6·67	1726	0·520		+0·0179
½ „ CO + ½ „	O + 2·1559 vols. O	5·83	1460	0·512		+0·0099
½ „ CO + ½ „	O + 3·1629 „ CO	4·79	1146	0·527		+0·0249

These numbers, in Bunsen's view, show that, in a mixture of carbonic oxide or hydrogen with the exact proportion of oxygen required for combustion, and unmixed with any diluent gas, only one-third of the carbonic oxide or hydrogen is burnt at the maximum temperatures, whilst the other two-thirds, by being raised to the high temperatures of 2558° to 3033°, have lost the power of combining; moreover, that, when one volume of the same mixture is diluted with 0·686 to 3·163 volumes of any gas that does not burn with it, and the temperature of the flame is successively reduced thereby from 2471° to 1146°, then, at all temperatures within these, exactly half of the carbonic oxide or hydrogen is burnt, the other half having lost the power of combining.

From this, it has been inferred that the combustion of gases takes place in a manner different from that which had been previously supposed. When a mixture of two volumes of carbonic oxide with one volume of oxygen is set on fire, and its temperature thereby raised from 0° to 3033° C., two-thirds of the carbonic oxide remains in an unburnt, and, for the time, incombustible state. The temperature is then lowered, by radiation and conduction, from 3033° to 2558° without any combustion of the carbonic oxide; but when the temperature falls somewhat lower, combustion recommences, restoring the heat lost by radiation and conduction, and raising the temperature again to 2558°, but not above that point. The gradual fall of temperature from 3033° is followed by a continuance of the temperature 2588°, till exactly one-half the carbonic oxide is burnt, whereupon a third phase sets in, during which, again, no combustion takes place until the inflamed gaseous mixture has cooled down to at least 1146°. As, however, the gaseous mixture, after cooling, consists almost wholly of carbonic anhydride, these alternate phases of constant and decreasing temperature must be repeated below 1146°, until the last portion of the gas is burnt. This discontinuous combustion of a uniform mixture of a combustible gas with oxygen, is referred by Bunsen to a law of combination established by him.

These facts, as observed by Bunsen, are of great importance in connection with the inflammation of gases, although it is probable as Berthelot has indicated, that Bunsen's temperatures are too high, in consequence of his not having considered the contraction of volume due to combination.

Berthelot * announced that the combustion temperatures in Bunsen's experiments may be anything between the limits shown in the following numbers, keeping the same numerical order as in the foregoing table:—

No.	t^1.	t.	No.	t^1.	t.
	°	°		°	°
1	4140	2612	8	2280	1875
2	3900	2537	9	2203	1838
3	3899	2449	10	2126	1715
4	3718	2389	11	2083	1734
5	3066	2198	12	1875	1548
6	2760	2154	13	1505	1319
7	2537	2031	14	1150	1034

A number of experiments on this subject have been made since Berthelot's criticism appeared; but the conclusions arrived at are contradictory. All, however, agree in observing a great absorption of heat at high temperatures, which is thought to be due either to a change in the specific heat of gases or to dissociation. MM. Berthelot and Vieille† and Mallard and Le Chatelier‡ have advanced and supported the former view; while the latter has been advocated by Mr. Dugald Clerk§ and Professor Rücker, of Leeds. It is probable that both causes operate to produce the phenomena which have been observed.

The rate of ignition of gaseous mixtures is also a point of considerable importance. Sir H. Davy‖ propounded a theory of this action; but it does not seem to be entirely supported by more recent investigations.

Bunsen found that the velocity of the propagation of combustion in a pure detonating mixture of hydrogen and oxygen was 34 metres per second; and in a maximum explosive mixture of carbonic oxide and oxygen, it was less than 1 metre per second. When the explosive gases are gradually diluted with a gas that does not take part in the combustion, the rate is lowered, and it can thus be brought down until the progress of combustion is made visible to the eye.

Bunsen's method of determining these velocities is thus described by Dugald Clerk (*loc. cit.*): The explosive mixture was allowed to burn from a fine orifice of known diameter, and the rate of the current of the gaseous mixture was carefully regulated by diminishing the pressure to the point at which flame passed back through the orifice and ignited the gases below it. This passing back of the flame occurs when the velocity with which the gaseous mixture issues from the orifice is inappreciably less than the velocity with which the inflammation of the upper layers of burning gas is propagated to the lower and unignited layers.

Professor Mallard¶ of the Ecole des Mines, made a series of observations by this method on the rate of the propagation of combustion in mixtures of coal gas and air, and of marsh gas and air. In the latter mixtures, the maximum rapidity of inflammation was found to be about 0·56 metre, or rather more than half a yard, per second. This velocity was attained with a mixture of 1 volume of marsh gas and 8½ volumes air. When the proportion of air was increased to 12 volumes, or diminished to 5·9 volumes, the mixture was neither explosive nor inflammable.** Professor Thorpe remarks on this that it is worthy of note that the proportion of air corresponding with the maximum rate of inflammation is less than that which contains oxygen sufficient for the complete combustion of the marsh gas. This, however, is what the observations by Bunsen and others, previously quoted, would lead us to expect.

The maximum rapidity of inflammation in mixtures of coal gas and air was attained with a mixture of 5 volumes of air and 1 volume of coal gas, and was 1·02 metres, or rather more than 1 yard, per second. One volume of coal gas with 6½ volumes of air gave a rate of 0·285 metre, or 11 inches, per second. The rate was very rapidly diminished by an excess of either constituent; a mixture containing more than 8 volumes and less than 3½ volumes of air to 1 of coal gas, was found to be uninflammable in the way described.††

Dugald Clerk has pointed out that these are the rates of ignition at constant pressure, and that in a closed space the conditions of inflammation are quite different in consequence of the expansion

* See also Thorpe, on the "Theory of the Bunsen Lamp," *Jour. Chem. Soc.*, 1877, I., p. 627, for Blochmann's investigations, or *Annalen Chem. Pharm.*, Vol. CLXVIII., p. 295.

† *Phil. Mag.*, Vol. XXXIV., p. 489, and "Gasometry," by Bunsen.

* *Ann. de Chim. et de Phys.* [5], Vol. XII. pp. 302-310; *Jour. Chem. Soc.*, Vol. XXXIV., p. 5; *Comptes Rendus*, Vol. LXXXIV. (1877), p. 407.

† *Essai de Mécanique Chimique*, Paris, 1879; *Ann. de Chim. et de Phys.*, 5me ser., XXVII. and XXVIII.; 6me ser., IV., pp. 13-84.

‡ *Comptes Rendus*, 1881, Vols. XCI., XCIII.; *Annales des Mines*, 8me ser. *Mémoires*, IV., p. 274. (Frequent references to the labours of these eminent scientists, as well as to those of MM. Berthelot and Vieille, mentioned in the preceding note, have been made in the JOURNAL.—ED. J. G. L.)

§ On the "Theory of the Gas-Engine," Min. Proc. Inst. C.E., Vol. LXIX. part iii., also Vol. LXXXV., pp. 1-53. See JOURNAL, Vol. XXXIX., p. 648; and Vol. XLVIII., p. 697. See also Rossetti, "On the Temperature of Flames." *Jour. Chem. Soc.*, Vol. XXXIV., pp. 467, 694, &c.

‖ "Researches on Flame." See also Watts's "Dict. of Chem.," art. "Combustion," I., p. 1089.

¶ *Annales des Mines*, Vol. VII., 1875, p. 355. Thorpe on the "Theory of the Bunsen Lamp," *Jour. Chem. Soc.*, 1877, I., p. 631.

** See also Coquillon's results in *Jour. Chem. Soc.*, 1877, I., p. 166, and in *Comptes Rendus*, 1876, Vol. XXXIII., p. 709.

†† *Comptes Rendus*, Vol. XCV., pp. 151-157; *Ann. de Chim. et de Phys.* [6], Vol. VI., 1885, pp. 546, 556.

of the ignited portion and mechanical disturbance of the remaining part of the gaseous mixture. Experiments are needed to determine the rate of ignition for constant volume. Some remarkable results are given by this author, which were obtained by so arranging the plan of ignition that a small volume of gases was first ignited, which expanded and projected a flame through a passage into the mass of an inflammable mixture; thus adding to the rate of ignition the mechanical disturbance produced by the entering flame. He succeeded by this means in producing maximum pressure (or maximum ignition) in 1-10th of a second in a space containing 200 cubic inches of gas. By firing a mixture with varying amounts of mechanical disturbance, almost any time of ignition could be obtained between 1-100th and 1-10th of a second. It did not matter whether the mixture used was rich or weak in gas; the rich mixture could be fired slowly, and the weak one rapidly, just as was required. He found that the rate of ignition of the strongest possible mixture is so slow that the time of attaining complete inflammation depends on the amount of mechanical disturbance permitted.

Mr. Lewis T. Wright has recorded * some interesting observations on the velocity of the propagation of flame, and has announced that, when flame travels at a greater velocity than 4½ feet per second, it will pass through the gauze similar to that used in safety-lamps. He also found that a flame of low velocity in a confined space may become so much agitated by an increase in its own oscillations as to cause the introduction of a very rapid rate of ignition in the remaining portions of the gaseous mixture. He remarks that "a definite explosive mixture may have a velocity of propagation of flame, when it is undergoing explosion of the first order, as low as 1½ feet per second; but when it becomes sufficiently agitated to give an explosion of the second order, the rate of propagation of flame is several thousand feet per second."

The following table shows the results of experiments with various mixtures of gases, giving the rate at which an explosion of the first order (that is, a slow ignition) travels with each mixture in a glass tube 13 feet long and 0·75 inch diameter:—

Mixtures.		Lineal Velocity of Efflux of Mixture.	Rate at which Explosion of First Order Travels in Tube.	Total Velocity of Propagation of Flame.
Gas.	Air.			
Per Cent.	Per Cent.	Feet per Second.	Feet per Second.	Feet per Second.
10·3	89·7	1·21	1 1	2·31
12·2	87·8	1·24	2·0	3·24
15·0	85·0	1·28	3·0	4·28
17·7	82·3	1·32	4·8	6·12
19·6	80·4	1·35	3·0	4·35
21·2	78·8	1·38	2·4	3·78
22·1	77·9	1·39	1·3	2·69
23·0	77·0	1·41	Stationary.	—

Wright also found that whenever an explosion is produced inside a safety lamp having ordinary gauze, the flame was projected through the gauze, and could ignite gas at a considerable distance from the lamp. By employing stiff wires for the woof and lighter wires for the warp, he produced a "basket-work" gauze, having small tortuous openings and a relatively large weight of metal, which did not allow flame from an explosion to pass through.

(To be continued.)

Register of Patents.

SUPPLYING CHARGES OF GAS AND AIR TO GAS-ENGINES.—Gazé, E. H., of Kilravock Street, London, W. No. 3964; March 14, 1888. [8d.]

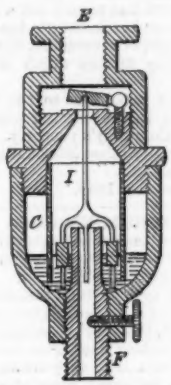
This invention of improvements in the mode of working gas-engines, has for its object to supply charges to produce kinetic energy at and during admission to the motor cylinders, the amount of which energy is increased by the heat of the explosions of the charges which are caused to occur without any further compression or re-compression in the cylinders. The invention further consists in supplying the motor cylinders of gas-engines with separate charges of compressed air and compressed gas in any desired quantities, so that they may mix in suitable proportions in the cylinders of the engines to be actuated; the pressure of the charges at and during admittance being used to propel the piston to the point of cut-off, where they are then exploded—the resulting expansion serving also to actuate the engines. These compressed charges are supplied to the cylinders at a low temperature; and the pressure is afterwards increased by the heat of the explosions. The amount of the initial compression of the air and gas is proportioned to the work to be done; and it can be varied (say) from 30 to 60 lbs. per square inch, so as to reduce the governing required, and to assist regularity of turning by adjusting pressures to loads.

REGENERATIVE LAMPS.—Cunliffe, W., of Brockley. No. 5092; April 5, 1888. [8d.]

This invention in "recuperative" or "regenerative" lamps consists (1) In providing for the variation, regulation, and control of the orifices and inlets for the admission of the atmospheric air to support the combustion and for determining and adjusting the quantity of air admitted so as to suit the different requirements of different localities with varying qualities and pressures of gas and other modified circumstances. (2) In making the body of the lamp of a lighter material and construction. (3) In simplifying its construction and adaptation in such a manner as to prevent the accumulation of carbon either at or above the burner in the chambers, and to enable any ordinary person to instantly take the whole of the body of the lamp apart for either lighting or cleaning, and replace the same without difficulty. (4) In arranging for the gradual supply of the air at all parts of both the inner and the outer surfaces of the flame, in quantity and continuity as required for giving an economical consumption of gas.

GAS-GOVERNORS.—Greene, T. A., and Walker, C. M., of Cannon Street, London. No. 2578; Feb. 13, 1889. [8d.]

This invention relates to the construction of a governor for regulating the supply of gaseous fluids, with an annular float situated in liquid subject to the pressure of the inflowing gas, which float has a central rising stem that butts against the underside of an inlet flap-valve so as to hold it in an open position without being connected thereto. In this way, any increase of pressure of the inflowing gas in depressing the level of the liquid, causes the float to descend, and the valve to close more or less by gravity.



In the illustration, the outer casing of the governor is shown closed at the top by a screw cap, to which is attached a cylindrical extension C passing down so as to leave a small opening between its lower end and the sides of the casing—thus dividing the space of the latter into a central or float chamber which communicates with the gas supply, and an annular outer chamber which communicates with the atmosphere. To the top of the cap is fixed a nozzle E by which the governor is connected to the gas-supply pipe; and the central chamber communicates with this through a passage closed at top by a pivotted flap-valve. Into the lower end of the casing is fitted an outflow-nozzle F, which projects up a certain distance into the float chamber, and the lower end of which is fixed to the outflow-pipe. The casing is charged with mercury, introduced through an opening on the top, communicating with the outer chamber C of the governor, and fitted with a plug so as to leave only restricted communication between the outer chamber and the atmosphere; the central chamber being cut off from such communication by the liquid seal at the bottom. In the central chamber is placed an annular float of any suitable material surrounding the nozzle F, and having a central stem L connected thereto by a bridge-piece. The lower end of the stem passes loosely into the opening of the nozzle F, which thus acts as a guide to it, while the upper pointed end butts against the apex of a conical recess on the underside of the valve so as to act as the upper guide to the stem. The quantity of liquid in the casing is so adjusted that the float will hold the valve open to a certain extent by means of its stem when the level of the liquid in the central chamber is slightly depressed by the normal pressure of the gas supply. On any increase of the pressure of the entering gas beyond the normal, this will depress the liquid level in the central chamber to a greater extent; causing the float to sink, and thereby allowing the valve to close to a corresponding extent, and consequently restricting the inflow of gas and diminishing its pressure, which action will be aided by the increased direct downward pressure of the gas upon the valve, and upon the float as explained.

APPLICATIONS FOR LETTERS PATENT.

5605.—FARRELLY, P., and SUDALL, J., "Gaslight illuminator." April 2.

5754.—GLOVER, S. & T., "Improvements in and connected with gas-meters." April 4.

5846.—WATKINSON, J., and DODD, T., "Improvements in gas-brackets, chandeliers, gaseliers, or the like." April 5.

5889.—HICKS, W. G., "An improved apparatus for admitting oxygen, air, or other gas or gases, into a coal-gas main in proportion to the make of such gas, and for varying this proportion at will." April 6.

5964.—MAIN, R. B. and A. P., "Improvements in gas-grills." April 8.

6081.—BATE, H., "Improvements in lenses for gas-lights, &c." April 9.

6090.—BRIGGS, F. H., "Improvements in or relating to apparatus for the manufacture of water gas." April 9.

6129.—FOX, S., and BLASS, E., "A method of and apparatus for altering the proportions of mixed gases." April 10.

6130.—FOX, S., and BLASS, E., "A method of and apparatus for adding volatile substances to gases." April 10.

6131.—FOX, S., and BLASS, E., "Improvements in apparatus for and in the manufacture of water gas." April 10.

6134.—STURGEON, T., "An improved gas-governor or apparatus for regulating or governing the flow of gas." April 10.

6226.—GRIFFIN, S., "Improvements in regulating the supply of gas to gas motor engines, and apparatus therefor." April 11.

6294.—ULRICI, G., "Improvements in gas-stoves." April 12.

6326.—MAIN, R. B. and A. P., and DARWIN, H., "Improvements in gas-fires." April 13.

* *Jour. Soc. Chem Ind.*, Vol. VI., pp. 862-864 JOURNAL, Vol. XLIX., p. 1076.

Correspondence.

[We are not responsible for the opinions expressed by Correspondents.]

INCREASING THE CONSUMPTION OF GAS.

Sir,—In the Journal for Jan. 15 last I notice a letter from Mr. W. A. Valon, in which he states that his Committee have under consideration a proposal to fit up houses free of cost. In referring to the matter in your editorial columns, you say: "We are not aware that any gas manager has hitherto gone so far as Mr. Valon in recommending that gas suppliers should fit up houses for consumers free of cost." I think I may claim priority. In August, 1888, I laid before my Directors a proposal to fit up shops, and the rooms attached to these, free of charge. The result of the trial during the four months to the end of the year was as follows:—

The number of houses gratuitously fitted up at the end of September was	21,	consuming	33,200 cub. ft.
Do. at the end of October was . .	32,	"	56,900 "
Do. at the end of November was .	39,	"	69,300 "
Do. at the end of December was .	51,	"	107,500 "

Financially, the experiment has turned out a great success.

Moveable fittings, such as brackets, pendants, and globes, &c., are charged for; but for this class of consumers, the Company's fitters make up, during slack time, cheap fittings which are sold at almost cost price.

Every applicant signs an agreement to the effect that he will take every reasonable precaution to prevent the pipes from being damaged, and that these remain the Company's property.

I shall be pleased to give any other information required to those who may wish to try the experiment.

H. Edwards.

Shanghai Gas-Works, March 8, 1889.

GASHOLDER CUPS.

Sir,—Absence from home has caused delay in replying to the letter on the above subject by "The Writer of the Sydney Gasholder Articles," which appeared in your issue for the 2nd inst.

The only case I referred to was that mentioned by "Engineer and Contractor" (*ante*, p. 535), of a holder 150 feet in diameter to which my arguments specially applied, though they were also generally applicable; but as "The Writer of the Sydney Gasholder Articles" has introduced it, I may ask: If the square form is so very strong and good for attaching the dip carriages, why was the small piece of angle iron put along the front of the dip underneath the carriage in that holder? In it the channel bar is 9¼ inches wide; that is a bearing of 9¼ inches without the piece of angle iron. In a round dip the bearing would be—

$$\frac{\text{cir. } 9\frac{1}{4} \text{ inches.}}{2} = 14\frac{1}{2} \text{ inches;}$$

and allowing 2½ inches, as the carriage would not be made to quite half a circle, this leaves 12 inches of bearing for the carriage—nearly 33 per cent. gain. Again, according to your correspondent's own showing, the dip carriage will tend to lift at the front—thus throwing all the square strain on the two front bolts; whilst in the round one we have four or more to be sheared across, giving at least twice the resistance.

Then as to the overstatements. The Sydney holder with its cups and dips of ⅜-inch and $\frac{5}{16}$-inch plates, is certainly an exception to the rule. But there are very few holders built now-a-days of that size with square cups and dips. Last year, to my knowledge, a holder 130 feet in diameter was erected with only $\frac{1}{4}$-inch plates; and the great majority of modern-built, though old-fashioned square-cup holders have the bottom circle of plates but two gauges thicker than the rest of the side sheets, to hold the cup channels and resist corrosion.

As most of the points raised by "The Writer of the Sydney Gasholder Articles" were ably answered in the article in the Journal for Feb. 19, it would be only waste of space to again go over his arguments *seriatim*. I therefore content myself by asking: If a box girder is the strongest form of tube, why is the circular section adopted in the Forth Bridge for all compression members?

I agree with your correspondent that makers of gasholders should know something of their construction. Hence it is that I consider the round cup and dip to be the most easily made and the most economical in all ways.

Designer.

April 15, 1889.

THE OPENING OF ROADS FOR ELECTRIC LIGHTING PURPOSES.

Sir,—I think it would interest a great many of the readers of the Journal to have an authoritative opinion expressed upon the following points; and I hope this letter may be the means of obtaining it:—

1. Whether the opening of the ground in any public thoroughfare for the purpose of erecting a support for carrying overhead and electric wires for public and private lighting, can be construed to be an obstruction similar to that provided for by the clauses of the Gas-Works Clauses Acts, 1847 and 1871, incorporated with the Electric Lighting Act, 1882, referring to breaking open the ground for the purpose of laying mains (or wires) for the supply of electricity.
2. Whether the Board of Trade have the power, and the will, to take the initiative in any action to prevent a person or persons from so illegally (?) opening the ground, in the event of any local authority condoning the offence, and not insisting upon the necessary License or Provisional Order, as the case may be, being obtained in the proper manner.

C. E.

April 16, 1889.

COUNTY AUTHORITIES AND THE LAYING OF MAINS ON BRIDGES.

Sir,—Referring to a letter on the above subject in your last issue (p. 716), doubtless "Main Layer" thoroughly understands his business of main laying, but when he attempts to deal with the sizes of the pipes to be laid, he is evidently lost; not perceiving that the area of two 5-inch pipes is only equal to half that of a 10-inch pipe. It is fortunate that the 9-inch pipe he mentions is not being worked to its full capacity, or he might ere this have found himself face to face with a difficulty, and perchance have learnt by practical experience that it takes rather more than three 5-inch pipes to do the work of a 9-inch one.

A. B. H.

April 17, 1889.

WATER BY MEASURE.

Sir,—Does "Low Pressure," whose letter appeared in the Journal for the 9th inst., expect his pet low-pressure meter to work reliably for any considerable time? He seems to assume that this particular meter, whatever it may be, will overcome all the difficulties and annoyances of constant inspection, whereas it has never yet been proved in a satisfactory way. It appears to me that, in the majority of houses, the low pressure meter must be a failure. It is quite bad enough to have a cistern in the roof, as at present; but "Low Pressure" would add to this a delicate machine which, in my opinion, will require frequent inspection and adjustment. There is no difficulty, if meters must be used, in fixing a high-pressure meter in as convenient a place as any gas-meter—in fact, this is frequently done; but it is a fact that, as a rule, water-meters are located in the first dark and dirty corner available.

It may interest "Low Pressure" and "Positive" to know that, as a consumer, I consider to adopt the meter system in any form, under present circumstances, would be a mistake. It would be of no advantage to the consumer, and a source of constant dispute between him and the vendor.

Consumer.

London, April 15, 1889.

Sir,—In reply to "Low Pressure," whose letter appears in the Journal for the 9th inst., who asks: "Why should a consumer be made to pay for the waste caused by a leak underground, or before the water has been delivered to him within the building?" I say: "Because the pipes and fittings are the consumer's property." Your readers will not be much enlightened by a controversy conducted in this manner.

I find no mention of charging the consumer for water wasted from defects in the company's portion of the service-pipes. I assume that "Low Pressure" fixes his meter on top of the cistern in the roof, and he expects the water company to pay for any leakage that may take place in the pipes from the garden gate to this meter. I fixed my meter in the pavement, outside the garden wall, or outside the boundary wall of a property, or immediately inside the wall, and expect to be paid for all the water that passes this meter, whether the consumer has underground leaks, broken pipes, defective hydrants and garden hose, leaky water-closets, or any other bad fittings, fountains, or wasteful appliances; and I also contend, contrary to the assertion in the letter of "True Measure" in the Journal for Nov. 27, 1888 (p. 942), that gas men do fix their meters just inside the boundary wall of the premises, and not at the end of the service in the sense and as explained in the fixing of this "low-pressure" meter at the extreme end of the service in the roof. I take it that the "end of the service" means that point where the Company's responsibility ends, and this is at the boundary wall of the property. It is here the water is said to be delivered to the consumer, and he carries his pipes through the garden and house, &c. Surely, no consumer will expect me to fix his meter inside his house in any position he may select, when he has perhaps 500 yards of pipe through his garden ground to the point where the cistern is fixed.

Three-fourths of the cisterns attached to the service-pipes under my care are, on an average, 150 yards from the boundary wall. My plan is to tap the main, and lay the pipe to the kerb, and there the company's responsibility ceases. All pipes beyond this position are the property of the owner or consumer; and he must repair all breakages, be responsible for the contamination of the water, and for damage accruing through burst pipes, &c. If the water is supplied for trade purposes by meter, he must, in addition, pay for the waste of water caused through underground leakage inside his meter on his own premises. Every meter inventor will know that; and here all discussion as to the position of the meter must end. It certainly cannot be fair for a water company to pay for bad plumbing, defective pipes, and apparatus on the consumer's property.

I am not prepared to abolish cisterns, as there cannot be such a system as constant supply without them. Supposing the main should break in the Strand, and the consumers had no storeage system, what would be the newspaper verdict, and what the inconvenience caused by such a new system as many of the magistrates, editors, and councillors are advocating? I can endorse all that was said on this subject in the Journal for Dec. 20, 1887 (p. 1090).

As to the relative merits of high and low pressure meters, your correspondent has advanced no further arguments in favour of his meter than are to be found in the Journal for March 13, 1888 (p. 466), replied to by your correspondent "Meter" in the numbers for Oct. 9 and 23, 1888 (pp. 632, 717), and in the correspondence on to the end of the year, to which I refer your readers.

If "Low Pressure" will state the progress he is making in this country with his meter, I, with many of your readers engaged in the distribution of water, shall be interested. All that can be said *pro* and *con.* for a supply of water by measure has been thrashed out, excepting the cost to be entailed on the City of London and on the consumers by the adoption of such a method; also the inconveniences, cost of inspection and collection, with figures adapted to the great London supply if turned into a meter system, taking the low-pressure meter as the standard measure. This problem I would ask "Low Pressure" to work out for your readers' benefit.

Positive.

April 17, 1889.

Mr. H. E. Jones on "Gas Examination."—Mr. H. E. Jones writes to point out that the opening sentences of his letter on "Gas Examination," as printed in last week's Journal, contained two inaccuracies, which we regret. To render the matter in question quite clear, therefore, we reproduce the sentences in their entirety: "You are mistaken in the belief that the inquiry into The Gaslight and Coke Company's appeal was the first court held by the Chief Gas Examiner. On behalf of this Company [the Commercial Gas Company], I have had to ask for an inquiry some two years back, in which a court was held, and evidence on both sides heard."

Parliamentary Intelligence.

HOUSE OF COMMONS.

TUESDAY, APRIL 16.

The Examiners reported that no Standing Orders not previously inquired into were applicable in the case of the Bristol Water Bill and the Plymouth Dock (Devonport) Water Bill; and that the Standing Orders not previously inquired into, which were applicable to the Coventry Corporation Water Bill and the Wakefield Corporation Bill, had been complied with.

The following further progress was made with Private Bills up to the Easter adjournment (April 16):—

Bills read a second time, and committed: Barrow Hæmatite Steel Company (Water) Bill, Barrow-in-Furness Corporation Bill, Newcastle and Gateshead Water Bill, Padiham and Hapton Local Board Bill.

Bill reported: Great Wigston Gas Bill.

Bills read the third time and passed: Faversham Gas Bill, Hythe Corporation Bill.

Petitions against the following Bills have been presented:—

Newcastle and Gateshead Water Bill, from the Duke of Northumberland, Messrs. W. Waddell and Sons, and Mr. J. G. Riddell.

Padiham and Hapton Local Board Bill, from the Mayor, &c., of the Borough of Burnley and Mr. J. Dugdale.

HOUSE OF COMMONS COMMITTEE.—TUESDAY, APRIL 2.

(*Before Mr.* J. STEVENSON, *Chairman; Sir* JOHN KINLOCH, *Mr.* BOLITHO, *and Mr.* WROUGHTON.)

MIDLAND RAILWAY BILL—THE LINACRE (LIVERPOOL) GAS-WORKS BRANCH.

Mr. BIDDER, Q.C., Mr. SAUNDERS, and Mr. WHITTAKER THOMPSON appeared for the promoters; Mr. LITTLER, Q.C., and Mr. MACRAE, for the Leeds and Liverpool Canal Company, who opposed the measure.

Mr. BIDDER, in opening the case for the promoters, said that clause 4 of the Bill proposed to authorize the construction of a railway somewhat over three furlongs in length in the township of Bootle-cum-Linacre. The proposed branch crossed the Leeds and Liverpool Canal to the Linacre Gas-Works. These gas-works consumed 120,000 to 130,000 tons of coal per annum; and the object of the Linacre branch was to put the works in communication, by means of the Midland line, with collieries producing gas coal, especially in the South Yorkshire district. At present the Company could get coals conveyed directly to their works only from these collieries reached by the canal. If they required coals from other collieries, they had to cart them from the nearest railway station. There was no objection to the proposal from anyone except the Canal Company, whose objection came to this; "These gas-works are on our shores; the supply of coal to them is our monopoly; and it is our right that it should remain our monopoly. In the interests of the perpetuation of that monopoly, we ask the Committee to reject the clause." The Gas Company attached great importance to the proposed railway, as it would enable them to improve the quality and cheapen the cost of gas.

Mr. *P. F. Garnett*, Solicitor and Secretary of the Liverpool United Gaslight Company, said they supplied the whole of Liverpool, Bootle, and the surrounding townships with gas. Their capital was £1,652,000; and their annual revenue about half-a-million. The profit, after paying the statutory dividend, was applied in reduction of the price of gas; and if they could cheapen the cost of manufacture, the whole public would thereby benefit. The statutory maximum price of gas was 4s. 6d.; but they were at present only charging 2s. 8d. The Linacre works were by far the largest and most important of the Company's stations. They were not at present in connection with any railway at Linacre; and the bulk of the coal came by canal. It was a matter of importance to the Company that this line should be made, in order to enable them to get coal from the South Yorkshire district, and also in order that they should not be dependent upon any single source of supply.

Mr. LITTLER: This pressing want of which you speak has not prevented you from reducing the price of gas in Liverpool?

Witness replied in the negative.

Mr. *W. King*, M. Inst. C.E., Engineer of the Liverpool Gaslight Company, said the quantity of coal consumed at the Linacre works last year was 133,508 tons. These were the works at which extensions would be made; and it was a matter of certainty that as time went on, the consumption would largely increase. The South Yorkshire coal was among the finest gas coal in the kingdom. In certain respects it was superior to the Wigan coal; and it was important, in the interests of cheap manufacture, that the Company should get considerable quantities of that coal. It was important that they should have access to as many sources of supply as possible.

Cross-examined by Mr. LITTLER, he could not say when the need for this branch line came into his mind; but having a railway within so short a distance of the works, it occurred to the Gas Company that it was in every respect desirable that a branch should be constructed to the works. They approached the Midland Railway Company with the view of inducing them to make this railway. The cost of the Wigan coal was 9s. 8d. per ton; and the cost of South Yorkshire, 10s. 6d. From the South Yorkshire coal 11,200 cubic feet of gas per ton was derived. This was, he admitted, a very high average. The Wigan coal produced 10,360 cubic feet per ton. At present they had to cart South Yorkshire coal to Linacre from the Langton Dock Station of the Midland Railway Company, who had no station at Linacre.

By the CHAIRMAN: The total consumption of coal in the whole of the Company's works would this year be about 300,000 tons. Of the coal consumed at Linacre, only 14,000 tons came by rail; the rest, by canal.

Mr. *Nobbs*, the General Manager of the Midland Railway Company, averred that if the proposed line was constructed, coal would be carried to the gas-works more cheaply, and delivered more advantageously than at present. The charge to the gas-works would be about the same as the present cost to the railway station. There was now in addition to that a rate of 10d. per ton.

Mr. LITTLER said that this was simply a Bill to extend the borders of the Yorkshire coal-owners, and to enable them to go into a district in competition with the Wigan coal-owners against the will of those whose property was to be interfered with. The Railway Company, he held, was entering into unfair competition with the Canal Company; and the only advantage of the Bill was to cripple the canal.

After a short consultation, the Committee found that the portion of the Bill relating to the branch railway was proved.

WE are informed that an order has been placed with Messrs. R. and J. Dempster, of Manchester, for the erection of sulphate plant at the Gateshead works of the North-Eastern Railway Company.

Legal Intelligence.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

FRIDAY, APRIL 12.

(*Before the* LORD CHANCELLOR *and Lords Justices* COTTON *and* LINDLEY.)

ABNISON AND OTHERS *v.* SMITH AND OTHERS.

THE CITY OF GENOA WATER-WORKS COMPANY, LIMITED.

This was an appeal against a judgment of Mr. Justice Kekewich,* delivered on Aug. 8 last year, in an action which was brought by Mr. J. Arnison and 53 other plaintiffs, debenture stockholders in the City of Genoa Water-Works Company, Limited, against Mr. Gordon Smith, the promoter of the Company, and the Prince of Mantua and Montferrat, Admiral Sir E. A. Inglefield, Colonel Hughes-Hallett, Sir Kingsmill Grove Key, and Messrs. H. C. Maudslay, H. F. Giles, and J. Kinloch Malcolmson, the original Directors of the Company. Of the 54 plaintiffs, 12 failed to appear at the trial, and two died before the trial. The plaintiffs alleged that they had been induced to apply for and became holders of debenture stock, amounting in the whole to more than £30,000, on the faith of a statement in a prospectus issued soon after the incorporation of the Company. This statement was to the effect that of the Company's share capital of £300,000, £200,000 had been already subscribed; whereas only seven shares—those of the subscribers to the Memorandum of Association—had been taken. The plaintiffs claimed damages for the deceit and misrepresentation contained in the prospectus. In their statement of defence, the defendants said that after the issue of the prospectus, and after applications for debenture stock had been received from the plaintiffs and others, the Directors in December, 1886, sent to the applicants (including the plaintiffs), a circular which contained the following statement:—"The £200,000 share capital, mentioned in the prospectus as being already subscribed, is an amount which has been appropriated to the contractors, to be issued to them as fully-paid shares in payment for the concession, and in part payment of the contract price for the construction and completion of the works and maintenance of the same for twelve months after. Each of the plaintiffs received this circular. On the receipt of the circular some of the applicants for debenture stock (but not any of the plaintiffs) demanded repayment of the money which they had paid on application; and their money was returned to them. Some of the plaintiffs had paid up in full the amount of the stock which they applied for; and to them the Directors sent with the circular a cheque for a discount of 6 per cent., which had been offered to applicants who should pay up at once in full. The remainder of the plaintiffs, after they had received the circular, paid up the balance due on the amount of the debenture stock for which they had subscribed, and all the plaintiffs afterwards on two occasions received a half-yearly payment of interest on their stock. The present action was commenced in October, 1887. There was evidence at the trial that the question whether or not the word "subscribed" was a proper one to use in the prospectus was considered and discussed by the Directors, and that after this discussion they decided to use it. Admiral Inglefield, the Chairman of the Company, said in the course of his examination, that he believed the word "subscribed" to be a truthful word. Mr. Justice Kekewich gave judgment in favour of the plaintiffs, other than the 12 who did not appear, with regard to whom the action was dismissed. His Lordship, in the course of his judgment, said that the misstatement relied on was short and simple, and, if construed as he thought it must be, absolutely untrue. It might be more severely characterized, but he gladly believed that many of the Directors wished to avoid deceit. Perhaps they were themselves victims—perhaps they were misled; but the language was theirs, and they were responsible. He did not think the subsequent correction by the circular of December was sufficient, especially as the circular contained no offer to return the applicants their money.

Mr. RIGBY, Q.C., and Mr. FARWELL appeared for the defendants appealing; Mr. NEVILLE, Q.C., and Mr. OSWALD, for most of the plaintiffs; and Mr. J. T. DODD represented the executors of a deceased plaintiff.

The LORD CHANCELLOR, in giving judgment, quoted Lord Selborne's language, when deciding the case of *Smith v. Chadwick*, to the effect that in an action of deceit it was the duty of the plaintiff to establish two things—first, actual fraud, which was to be judged of by the nature and character of the representations made, considered with reference to the object for which they were made, the knowledge or means of knowledge of the person making them, and the intention which the law justly imputes to every man to produce those consequences which are the natural result of his acts; and, secondly, he must establish that this fraud was an inducing cause to the contract for which purpose it must be material; and it must have produced in his mind an erroneous belief, influencing his conduct. He (the Lord Chancellor) was of opinion that in the present case all the elements referred to by Lord Selborne had been established; and he was not able to concur with Mr. Justice Kekewich in the view he had taken as to what the defendants had done. He (the Lord Chancellor) was unable to reconcile the fact that the defendants had made statements in the prospectus which were untrue, and which they knew to be untrue, with a desire on their part to avoid deceit. If the statements were made, and made with knowledge, it could not be said that the defendants sought to avoid deceit. Mr. Justice Kekewich had also remarked that perhaps the defendants were themselves misled. But, looking at the facts and having regard to the evidence, he (the Lord Chancellor) did not entertain any doubt that the fraudulent statements made by the defendants were intentionally made. Not one of the Directors could say that they did not know the meaning of the words which were inserted in the prospectus; that must be taken as part of the admitted facts. The Directors had discussed the matter, and had been advised that they might use the words as being appropriate. Therefore the defendants were, in his Lordship's opinion, guilty of fraud. As to the first part of the case, therefore, he was satisfied that this was a fraudulent prospectus, issued with an intention to deceive the persons who were in fact deceived, and that consequently the defendants were responsible in damages. The next proposition was as to the persons who had been injured by these fraudulent statements; and that depended upon whether they had been induced to enter into the contract to take shares by those statements. On this point he had come to the conclusion that the plaintiffs were induced by the fraudulent misrepresentations of the defendants to enter into the contracts to take shares; and, in consequence, had suffered the damage which they had. He had now to deal with the argument that by issuing the circular there had been a recantation by the Directors of what they had done. If, after this deceit was practised, the Directors had gone to each person whom they knew had been deceived, and explained the circumstances and offered to return his money, the case might have been different. It seemed clear that the circular was not intended to convey the real condition of affairs. Under these circumstances, it seemed to him that the circular made no difference to the liability the Directors had incurred in issuing the

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* See JOURNAL, Vol. LII., p. 293.

prospectus; and he therefore came to the conclusion that Mr. Justice Kekewich's decision was right, and that the appeal had failed.

Lord Justice COTTON came to the same conclusion, but on somewhat different grounds. He discussed the facts of the case; holding that the defendants were liable for the statements made in the prospectus. He entirely concurred in the view expressed by the Lord Chancellor on the other parts of the case, and thought that Mr. Justice Kekewich's decision ought to be affirmed.

Lord Justice LINDLEY delivered judgment to the like effect.

The appeal was therefore dismissed, with costs.

There was a cross-appeal by nine of the twelve plaintiffs, as to whom the action was dismissed by Mr. Justice Kekewich. As to this their Lordships expressed the opinion that the order made by Mr. Justice Kekewich should be varied by adding a direction that such dismissal of the action was without prejudice to those plaintiffs commencing a fresh action.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

TUESDAY, APRIL 16.

(*Before Mr. Justice* KAY.)

BLAKER *v.* HERTS AND ESSEX WATER-WORKS COMPANY, LIMITED.

THE CLAIMS OF DEBENTURE-HOLDERS.

In this case a question of general importance arose as to whether the undertaking of the defendants was of such a "public" character that the Court would decline, at the instance of a debenture-holder, to order a sale of the undertaking and appoint a manager thereof. The plaintiffs were debenture-holders suing on behalf of themselves and all other debenture-holders of the defendant Company; and they claimed to be entitled to a charge on the undertaking, lands, works, plant, property, and effects, both present and future, of the Company, to secure the principal and interest due on their debentures, an account of what was due on the debentures, and that the undertaking and other property and effects of the Company might be sold as a going concern. The undertaking was initiated by a Provisional Order, under the Gas and Water Works Facilities Act, 1870, obtained in 1879. Clause 5 of this Order provided as follows:—"William Russ and Charles Minns, and the survivor of them, and the executors or administrators of such survivor, their or his assigns, shall be the undertakers for the purposes of this Order, and are in this Order referred to as the undertakers." The capital sanctioned by the Order was not to exceed £25,000 unless the undertakers were authorized to raise additional money by Provisional Order under the above-named Act, or by Act of Parliament. By clause 7 the amount to be borrowed in respect of the undertaking was limited to £6250, the rate of interest on which was not to exceed 5 per cent. The undertakers commenced and carried on the works for a time; and ultimately they assigned the whole undertaking to the defendants—a joint-stock Company formed under the Companies' Act, 1862. By the terms of the assignment, the purchase-money was to be paid in shares and debentures issued by the Company. The Company proceeded to issue debentures as part of the price; and the plaintiffs were holders of debentures so issued. By the debentures it was stated: "The Company do hereby charge with payment [of the money borrowed] the undertaking, lands, works, plant, property, and effects (both present and future) of the Company, to the intent that this security and the other securities forming part of the above-mentioned issue of £6250 may rank equally as a first charge upon the said undertaking, lands, works, plant, property, and effects, both present and future, but so that the same may be a floating security, not hindering any sale, exchange, or lease of the said lands or any part thereof, or the receipt or payment of any moneys, or any other dealings in the course of the business of the Company, but attaching to the premises leased and the proceeds of any sale or exchange of the lands or property purchased therewith, and all other the property for the time being, whether real or personal, of the Company." In 1885 a Provisional Order was obtained by the Company, in which it was provided expressly that the defendant Company should be the undertakers for the purposes of the Order, and in the Order were referred to as "the undertakers." Additional powers of raising share and debenture capital were given to the Company, and the Order was to be construed together with the former Order.

Mr. RENSHAW, Q.C., and Dr. F. THOMSON appeared for the plaintiffs; Mr. MARTEN, Q.C., and Mr. PRIOR for the defendants.

Justice KAY, in giving judgment, recapitulated the provisions of the Act of 1870 and the Order of 1879, as above set out, and continued: Obviously, by the terms of this Order, it was intended solely as a mode of providing water-works for a particular district. This is manifestly for purposes entirely public; and it is to be observed that the mortgage referred to is a mortgage of the undertaking only. I do not know what power of mortgage was given to the joint-stock company. My attention has not been called to any part of any Act which gives them a power to mortgage; and the only mortgage referred to in the Order of 1879 is a mortgage of the undertaking thereby authorized. Pausing there, it would seem to have been contemplated that the undertakers might raise by mortgage of the undertaking a sum of money not to exceed £6250, at a rate of interest not higher than 5 per cent. Then what took place afterwards was this: The undertakers commenced and carried on the works for some time, but ultimately assigned the whole thing to the Herts and Essex Water-Works Company, Limitsd—a Company formed under the Act of 1862. The terms of the assignment were that the purchase-money was to be paid in shares and debentures; and thereupon the Company proceeded to issue debentures as part of the price. The debentures in respect of which the plaintiffs sue are debentures so issued. The next question to be considered is what was the meaning of the parties who entered into these debentures. They are in this form: "The Company in consideration of the sum of £50 paid to them by Easton [who had then become the undertaker, I understand, to whom the debentures were issued] agrees with him to pay the debentures on the 1st of July, 1888, of £50; and the Company doth hereby charge with such debentures the capital, lands, works, property, and effects both present and future of the Company, to the intent"—I pause to remark that the words are larger than in the Order I read, because there it was that the undertaking was to be mortgaged, and nothing else—"that this security, or the other securities forming part of the above issue of £6250 may rank equally as a first charge on the said undertaking, and the lands, works, plant, property, and effects, both present and future, so that the same may be a floating security not hindering the sale, exchange, or lease of the said land, or any part thereof, or the receipt or payment of any moneys, or any dealings in the course of the business of the Company, but attaching to the premises leased, and the proceeds of any sale or exchange of the lands or property purchased therewith, and all other property for the time being, whether real or personal, of the Company." There I have a very distinct statement that these debentures should not hinder, amongst other things, any dealings in the course of the business of the Company. The debenture was to be, and I must construe it to be, only a charge on the undertaking; and it was to be such a charge on the undertaking as would not hinder any dealings with the Company. Then it is said, "That is true enough until the day for payment arrives; but after that day the mortgagees may agree. If they all agree, they may themselves sell the property under the powers contained in the Conveyancing Act; and if they cannot all agree, any two or more of them may come, and on behalf of all, get the Court to sell." But, in the first place, there is no power of sale mentioned in the debenture; and, secondly, I do not at all agree that the Conveyancing Act applies to a charge of this kind. It applies to an equitable mortgage, no doubt; but it does not mention in the interpretation clause, or in any other part of the Act that I am aware of, debentures as one of the particular charges to which its provisions are to apply, and I should expect in an Act of that kind, if it were meant to give debenture-holders—that is, holders of charges created by companies—such a power, it would have been stated in very express words indeed. I am, therefore, clearly of opinion that the power in the Conveyancing Act does not apply to debentures of a joint-stock company. The real question is, Can the Court under the general jurisdiction conferred first by the 15 and 16 Vict., Cap. 86, and now continued by the 25th section of the Conveyancing Act, direct a sale? [His Lordship referred to the cited section of the Conveyancing Act, and to the decisions in *Potts v. The Warwick and Birmingham Canal Company*, and *Gardner v. The London, Chatham, and Dover Railway Company*; quoting the judgment of Lord Cairns in the latter case to the effect that the undertaking meant the completed works of the company when constructed, and that the charge gave to the debenture-holder a right to the produce—the "fruit" as Lord Cairns called it— of the undertaking.] I confess that seeing that the first Provisional Order contemplated a mortgage of the undertaking only, that the mortgage is then made in the form of debenture, which contemplates that it is not to interfere with the carrying on of the business of the Company, it seems to me that the principle of *Gardner v. The London, Chatham, and Dover Railway Company* applies, and that the debenture gives to the holder no more than the "fruit" of this water-works undertaking, and not the power to sell the undertaking. The debenture seems to me to show, on the face of it, that it did not give the holder power, by selling to some other person, to put a stop to the undertaking altogether, because I cannot assume that selling would not put a stop to the Company's operations. It is true that in the first Order the undertakers are treated as the two persons named or their assigns. They have assigned to the Company; but after the Company had taken the assignment (and no doubt after the debentures were issued) a new Order was obtained in 1885; and there it was provided expressly that the Herts and Essex Water-Works Company, Limited, should be the undertakers for the purposes of the Order. This Order was to be construed together with the Order of 1879, so that practically it recognized the limited Company as being the persons who had become entitled to all the rights under the original Order; but it does not mention any assigns of theirs. So I take it that, without some authority, the Company would not be at liberty at all to assign over those rights. It is said that this does not matter, because it could not have been intended that any rights the mortgagees might have should be taken away from them by force of the Provisional Order. But it must be remembered that the mortgagees have had the benefits of the additional powers which the Provisional Order gave to the Company; and therefore it would be very difficult indeed for them to say that notwithstanding the benefits they had received, they had still rights which existed before the Provisional Order was granted. My view is that they have not any such right as that which they contend for. No case has been mentioned, and I myself am not aware of any, in which a water or a gas undertaking, formed under one of these Provisional Orders, has been sold by, or at the suit of, debenture-holders. I should certainly hesitate to make, for the first time, an order of that kind, particularly in a case like this, and looking at the whole transaction—that only a mortgage of the undertaking was authorized by the first Provisional Order, and that the form of the debenture contemplated the carrying on of the business of the Company, notwithstanding the existence of the charge upon it. Looking at all the circumstances, it would not be right to make any order authorizing the sale of the works or the breaking up of the Company in any way. Then the question is, Can a manager be appointed? The business is not comprised in the mortgage; and the charge was not to hinder or interfere with the business of the Company. Therefore, it seems to me that in this respect the case is within the decision of *Gardner v. The London, Chatham, and Dover Railway Company*. We all know that after that case, an Act was passed authorizing the appointment of managers; but this Act does not apply to a case like the present, but only to railway companies. Therefore I think the only relief I can give is to direct an inquiry as to who are the debenture-holders, an account of what is due to each of them, and to appoint a receiver.

On the application of Mr. RENSHAW, his LORDSHIP said he would make a declaration that the debentures were a first charge on the undertaking of the Company, and the plaintiffs might add their costs to their security.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

TUESDAY, APRIL 9.

(*Before the* LORD CHIEF JUSTICE.)

BUTE DOCKS *v.* THE MERTHYR GAS COMPANY.

THE DISCHARGE OF REFUSE INTO THE RIVER TAFF.

This action was heard by his Lordship at the Monmouth Assizes on the 2nd ult.; and to-day he delivered judgment, in which he dealt with all the facts of the case.

Mr. JELF, Q.C., and Mr. A. T. LAWRENCE appeared for the plaintiffs; Mr. BOSANQUET, Q.C., and Mr. SPOKES for the defendants.

His LORDSHIP said this was a case in which, after the jury had answered one or two questions, they were discharged; and the case was left to be determined by him. The action was brought by the Bute Docks under the Rivers Pollution Prevention Act, 1876, and was in substance an action against the defendants for obstructing the River Taff, and interfering with its due flow, by throwing into it rubbish, cinders, or solid refuse. The Bute Docks was an enormous concern, administered by the Bute Trustees, who were the owners of two very large docks, and a number of auxiliary basins. Amongst other things, from the Bristol Channel, just where the River Taff flowed into it, they had an excavated channel, which had to be kept clear to a certain depth by dredging, in order that the ships which availed themselves of the Bute Docks should have access thereto. An enormous traffic in coal was done at these docks. It was proved that this channel, in addition to the filling up which would occasionally occur in such a place, was considerably obstructed by solid lumps of coal, by cinders, clinkers, and a variety of things, which were from time to time found in the shoals or shallows of the channel, and which could not be the natural results of the river flowing down into this place. They must have been put there by somebody; and the case for the plaintiffs was that a large or appreciable quantity was put there by the defendants, who were the proprietors of the gas-works at Merthyr Tydfil. Merthyr Tydfil was between 20 and 30 miles from the mouth of the Taff. There was evidence given, which he entirely believed, by one witness, that a year or two ago he had seen a large block of rubbish, some clinkers, and other solid materials collected just outside the river wall of the gas-works, and which

it was not denied was the refuse of the works. There was some discussion as to the exact amount which was swept down the Taff by a flood. It was asserted that at one time there was about 40 tons; and it was said that, if it did not get caught in the holes in the river, it would, sooner or later, come down to the mouth, where it opened nearly at right angles into this artificial channel, and no doubt some portion of it would get into it. But all difficulty on this point was removed by a very frank admission by Mr. Bosanquet, that 100 tons of solid matter of different kinds, including bricks and clinkers, were discharged from the gas-works into the Taff. Thereupon, in reply to a question, the jury said they should assume that a very considerable quantity of solid matter was discharged by the defendants and by other works into the Taff or the Rhonda. For the purposes of his judgment, therefore, he had to deal with an admitted quantity of 100 tons a year of this stuff coming from the defendants' works into the Taff. What became of each particular piece of stuff that came from the gas-works after it was put into the river, he could not say; but the reasonable inference was that at some time or other, sooner or later, depending on the presence or absence of floods, a considerable portion of it was carried into the channel. "Sooner or later" was not a mere chance expression, because to his mind it went very much to the point of the case. If the Taff were an uninterrupted rapid mountain stream between Merthyr and Cardiff, with no impediments across it, the inference would be that anything which was thrown in at the defendants' works would be carried right down to the plaintiffs' channel. But that would be a state of facts very different from that with which he had to deal. The Taff had at least seven head weirs put right across it, for the purpose of the various works which had been erected at different intervals down the stream, and which had acquired the right, by purchase or user, of using the water of the Taff for their machinery. Therefore, between Merthyr and Cardiff, seven direct obstructions which were either legal in their inception or had become legal by lapse of time, and at times—not always, because, of course, in times of flood there was an enormous cataract over these weirs—in the summer, especially, the whole or almost the whole of the stream was diverted into the different works, passed through them, was discharged below them, and went down the Taff until it met with another obstruction; and the same process was repeated seven times between Merthyr and Cardiff. This was proved in evidence, and was not disputed. Therefore, it was of importance to consider whether the stuff in the Taff was carried straight, without impediment, from Merthyr to Cardiff or not. It had been proved beyond all doubt to his mind that it was not so carried; that the seven weirs each made, so to speak, a fresh beginning to the waters of the Taff in ordinary times; that it was only in times of flood that they overflowed to any large extent; and that whatever was penned up by them was carried over. Another matter which was proved, and was also of importance, was that the flow of the Taff had certainly not been interfered with in this sense. It was a rocky stream coming down from the mountains; and even near Cardiff, and nearly the whole of the way down, had such a rocky bottom that from time to time in the summer a great part of the channel was frequently laid bare, so that one could tell very well what the nature and depth of the channel was. It was proved beyond all question by witnesses for the plaintiffs that there was no appreciable difference in the bottom of the Taff ever since they had known it; and that there was no reason to think that the bed of the river had been at all altered and filled up. It was also elicited by Mr. Bosanquet that, though it was exceedingly difficult to say to what exact extent, there were undoubtedly other contributory causes to the rubbish and stuff which was to be found in the shallows, which had been created, and which had increased in the artificial channel which the Bute Docks had to keep clear. First of all, there was the fact that at the docks very large quantities of coal were poured into the vessels which lay alongside the quays; and it was said, with manifest good sense, that, however much care was exercised in loading millions of tons of coal in the year, it was inevitable that there would be a considerable quantity which would fall into the dock. Then it was also proved that a large number of tugs constantly used these docks in taking ships in and out; and it was suggested that a great deal of their cinders and refuse were thrown overboard somewhere about the entrance to the artificial channel. He thought it was exceedingly likely that they threw some of their cinders out here. It seemed to him, therefore, that there was a good deal of evidence to show that the substantial obstruction did not come from the Merthyr works, which were between 20 and 30 miles away; and it was certainly not proved that there was any more than was admitted—viz., 100 tons of this stuff thrown into the river during the year from these works. Now 100 tons of stuff distributed over 20 miles of river, with seven intervening headweirs and deep mill-pools, into which the heavier part would go, and would certainly not be swept away except by extreme floods, would not have very much effect. At all events, the plaintiffs had failed to satisfy him that the obstruction of which they complained was due in any appreciable sense to the Merthyr Gas-Works. It stood to reason that, there being at least seven other works between Merthyr and Cardiff on the Taff, and several others, at all events, on the Rhonda, which discharged into the Taff, that a great deal of what was complained of came from sources other than the defendants' works. On the evidence his decision was that no interference with the due flow of the stream had been shown even in the words of the Act of Parliament—viz., a contribution to it, or a creation of obstruction by repeated acts. The evidence—and it was the evidence for the plaintiffs—showed that there was no interference with the due flow of the Taff by the defendants in this case; and, therefore, he must give judgment for the defendants with costs.

It was arranged that execution should be stayed for a month.

HIGH COURT OF JUSTICE, IRELAND—EXCHEQUER DIVISION.

THURSDAY, APRIL 18.

(*Before Chief Baron* PALLES, *Baron* DOWSE, *and Mr. Justice* ANDREWS.)

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY *v.* THE CORPORATION OF DUBLIN.—THE PUBLIC LIGHTING QUESTION.

To-day the action taken by the Alliance Gas Company against the Dublin Corporation in regard to the public lighting, to which reference has already been made in the JOURNAL, was before the Court.

Mr. WALKER, Q.C. (with whom was Mr. R. ADAMS), moved, on behalf of the defendants, that all proceedings in the action be stayed, and that the matters in dispute be referred for arbitration, in the manner prescribed by the Gas-Works Clauses Act, 1871. He said that the action was brought to recover the price of three quarters' gas supplied by the Company to the Corporation for the public lighting of the city. A long correspondence had taken place between the parties, and the Corporation had paid the Company £5000 on account, without prejudice to their denial of liability for the remaining £1800. The Act of 1871 provided that all matters in dispute between the undertakers (*i.e.*, the Gas Company) and the local authority in relation to the consumption or supply of gas should be settled by arbitration; and it provided for a submission to arbitration on both sides, and for the appointment of arbitrators. Under these circumstances, he made this motion, and supported it by the affidavit of the Town Clerk (Mr. Beveridge). In this affidavit Mr. Beveridge admitted that it was quite true that the amount charged for the gas was at the same rate as it had been for several years past, but said the defendants alleged that the quality was below the legal standard, that the quantity charged for was not supplied, that the lamps were not kept in proper order, that facilities had not been afforded for testing the gas, nor proper apparatus provided, and that the testing-place was on an improper site. He then submitted that this matter should be referred to arbitration, and that if such an arbitration were held, the claim of the Company would be reduced by about £1800.

The CHIEF BARON remarked that under the Act a person was to be appointed to test the illuminating power of the gas. Was there such an appointment?

Mr. WALKER said there was—Professor Tichborne was appointed, but his opinion was not made conclusive. A judge and jury would not be the proper tribunal to decide this case; and a submission for an arbitration was drafted and sent to the Company. The Corporation had appointed Mr. Vernon Harcourt—one of the Metropolitan Gas Referees—as Arbitrator on their behalf.

Baron DOWSE: Could you not get any one in Ireland?

Mr. WALKER: No, my Lord; I believe not.

Mr. MARTIN, Q.C. (with whom were THE M'DERMOT, Q.C., and Mr. HOLMES), on behalf of the Company, said that the plaintiffs did not desire to raise any technical objection to the motion of the Corporation.

Mr. WALKER said the Company did not object to an arbitration on the matters in dispute with regard to the future, but they objected to an arbitration in reference to the past. The Corporation, however, were of opinion that it would be very inconvenient to have two litigations proceeding at the same time—one as to the future and the other as to the past. There was an affidavit from Mr. Cotton (the Company's Secretary and Manager) in which he stated that "there was no excess in the supply of gas to the Corporation, as shown by the Corporation's own returns; that Professor Tichborne, the Gas Examiner of the Board of Trade, had tested the quality of the gas, and that the result of his testing showed that on no occasion had the quality of the gas fallen below the legal standard; that the defendants had given no particulars in support of the statement made by them that the amount of gas charged for was not supplied, although called upon to do so; that the allegations as to the want of repair of the lamps were mere vague statements unsupported by any particulars, and that the same observation applied to the allegation as regards the testing of the gas; and that the matters referred to were merely introduced for the purpose of delaying and annoying the plaintiffs, and preventing the payment to them of what was justly due." Well, this was answered, as regards the delay, by the fact that the Corporation had paid the Company £5000 on account.

Mr. MARTIN remarked that the Corporation wished to get rid of the regulators on the lamps.

Mr. WALKER said they wished to have proper regulators.

Baron DOWSE thought it was a pity that two important public bodies should not settle this matter without litigation.

Mr. WALKER said that of course an arbitration would settle all matters in dispute as to the future as well as the past; and it would be desirable on both sides that these disputed questions should be settled.

Mr. MARTIN said the Company were anxious to bring the matter to a settlement; but with regard to the past, when the accounts for the three quarters in question were furnished, the Corporation did not raise any objection as to the illuminating power of the gas.

Mr. WALKER replied that repeated complaints were made. The learned Counsel was continuing his remarks when

The CHIEF BARON said the motion could not go further then, and as the case would have to stand over for some days, possibly some progress would be made towards an ultimate settlement of the matters in dispute. The Corporation could make a statement of their counter-claim, and send it to the Gas Company, who could strike out what they objected to.

It was then decided that the further hearing of the case should be adjourned until the 29th inst.

THE LIGHTING OF GALATZ.—A despatch has been received at the Foreign Office from Her Majesty's Consul-General at Galatz, reporting that the Municipality of that town are prepared to receive tenders for the public lighting either by gas or electric light.

THE PRICE OF GAS AT CHAPEL-EN-LE-FRITH.—Last Tuesday a public meeting was held at Chapel-en-le-Frith to consider the price and quality of the gas supplied in the town. It was stated that the Lighting Committee had complained of the bad quality and the high price of gas (5s. 6d. per 1000 cubic feet) to the Everton and West Derby Building Society, who are the owners of the gas-works; the result being that they had offered to sell the works, a cotton-mill, cottages, &c., for £6500. This the meeting considered to be a most outrageous price; and the Chairman (Mr. T. Howarth) said the proprietors had often before expressed their willingness to sell the whole property for £5000. Had they offered the gas-works separately, a company might have been formed to purchase them. Eventually the meeting passed a resolution expressing dissatisfaction with the price and quality of the gas supplied.

THE LIGHTING OF PRESTON STREETS.—In a series of articles in a local paper on "Old Preston: Its Manners and Customs," Mr. T. Harrison Myers states that the town is badly lighted. Dealing with the subject historically, he says that in the year 1699 the Corporation ordered a better system of lighting the streets to be adopted. It was resolved by the Council that "for the better going in the streets in the winter evenings in the decrease of the moon, or when clouds interpose, it has been thought necessary that some lamps or convex lights should be provided." Four oil-lamps were ordered from London; and these had to be placed in the best parts of the town—fixed in the Market-Place, near the Old Church, Main Sprit-Weind, and the Butter Cross. As time went on more lamps were used. Preston was the first provincial town lighted with gas, in the year 1815; and its Parish Church was the first church so lighted. The Board of Trade return states that there are 2300 lamps in the district of Preston. The lamps in the Preston streets and district burn 18 million cubic feet; those at Blackburn, 44 millions; Bolton, 46 millions; Bury (about half the population of Preston), 20 millions; and Carlisle, with a population one-third of Preston, 19 millions. Preston burns, in its public lamps, about 186,000 cubic feet for every 100 of its inhabitants. This is the lowest in Lancashire; the highest being 720,000 cubic feet, or nearly four times the quantity burnt in Preston. "These figures," says the writer, "clearly show the cause of the defective lights of the streets; and it is a fact, much to be deplored, that although there are 50 per cent. more lamps than in 1864, Preston burns no more gas than it did then, which clearly accounts for its being the worst-lighted town in Lancashire. Is it right that the Corporation, who have the entire charge of lighting and attending to the lamps, should cater for us in this manner?"

Miscellaneous News.

RAMSGATE CORPORATION GAS SUPPLY.

ADOPTION OF MR. VALON'S SCHEME FOR INCREASING THE CONSUMPTION OF GAS.

At the Meeting of the Ramsgate Town Council last Thursday—the MAYOR (Captain L. W. Vaile) in the chair—the scheme for increasing the consumption of gas which, as our readers are aware, has been proposed by the Corporation Gas and Water Engineer—Mr. W. A. Valon, Assoc. M. Inst. C.E.—was considered. The matter came up on certain recommendations of the Gas and Water Accounts Committee, who at their meeting on the 27th ult. recommended as follows:—"That a trial be made of fitting, at the expense of the Gas Department, houses at a rental not exceeding £30 per annum with supply-pipes, meter, plain brackets, burners, and boiling-ring." At an adjourned meeting of the Committee, held on the 4th inst., the foregoing recommendation was read and confirmed, and the following additional recommendations were made:—

1. That the meter used have a prepayment index.
2. That the price of gas supplied under these conditions be at the rate of 4½d. per 100 cubic feet, not less than 400 cubic feet to be paid for in advance; this price to include rent of fittings, meter, and all other expenses.
3. The extra charge for gas consumed under these conditions to be apportioned towards defrayment of additional expense incurred.
4. The accounts to be collected weekly by an inspector.
5. That, for the present, applications be entertained for fitting 200 houses only.
6. Applications for supplies under these conditions will be considered in the order in which they are received; it will therefore be necessary for persons desiring to be included among the first number to made immediate application.

Alderman PYGOTT (Chairman of the Gas and Water Committee), in moving the adoption of the Committee's recommendations, said that, after careful consideration, they had decided to try what might be described as an experiment in the direction of giving greater facilities for the supply of gas to small householders, and one which could, he believed, be carried out without injury to themselves. The experiment would, in fact, lie more with the inhabitants than with the Corporation, seeing that no expenditure whatever would be incurred unless householders themselves came forward and asked for a supply of gas on the favourable terms now agreed upon. Several of the great objections at present made to the introduction of gas to small houses were removed—such as payment for fittings and meter, or a deposit on the latter. Under the plan now brought forward, this was dealt with in quite a different way. The price of gas supplied to householders according to this plan would be 7d. more per 1000 cubic feet than that supplied to consumers in the ordinary way. This sum would be sufficient to insure the gas undertaking against any loss which might be incurred for the meter, and so forth. The meter that would be used for this purpose was one which was the invention of their esteemed Engineer; and it was so arranged that, on a certain quantity of gas passing through, the supply could be stopped at a fixed point. A meter of this kind would be supplied to each householder requiring it on payment of a certain number of feet of gas. The meter would run the number of feet of gas for which payment had been made; and in this way consumers would get the actual supply which had been arranged for. People who lived in small houses were necessarily of a more migratory character than those who dwelt in larger houses; so that the Corporation secured themselves from loss by requiring payment in advance. The arrangement was not only a good one for the people themselves, but also of great advantage to the gas undertaking. The necessity for doing something of this kind had long existed, as there was great difficulty in the way of dealing with occupiers of small houses, on account of the objections entertained to the preliminary expenses. It was proposed to use iron pipes for the conveyance of the gas from the mains; so that it would not be worth the while of any householder to take them away with him on leaving a house. To his (Alderman Pygott's) mind, one of the great recommendations of the scheme was that there would be no outlay by the Gas Department against which they were not secured. Unless an offer was made by each individual householder, no pipes would be introduced to his house. It was proposed by the Engineer to deal with not more than 200 houses in the first instance; and the average expenditure was set down at about £4 per house, for which they were sure of a return as they went along. Of course, if at any time they found that the scheme did not answer, they would put a stop to it at once. Referring to the use of oil and electric lighting in Ramsgate, he said he did not think the latter would ever prove a very serious competitor with gas in a town like Ramsgate. Speaking as a burgess, it was in their interest, as proprietors of the gas-works, to sell as much gas as possible, seeing that an increase of the profits on the gas undertaking meant a decrease in the district rate; and if by burning oil they reduced the quantity of gas consumed, there would be a proportionate increase in the district rate.

Mr. CLEMENTS seconded the adoption of the report. He said he was quite sure they were acting rightly in adopting this scheme; and he believed that their example would soon be followed by the proprietors of many other gas-works. They ought to consider themselves fortunate in having the services of so eminent an Engineer as Mr. Valon, who should be specially congratulated on the most important invention in meters which had taken place for many years past, and which he was sure would be gladly adopted everywhere. Owing to the favourable terms offered to small householders, he was quite sanguine as to the entire success of the scheme.

Mr. HART remarked that he had nothing to say against the new departure; but he was at a loss to understand why 7d. more per 1000 cubic feet should be charged to small as against large consumers. Of course, he quite granted, as explained by the Chairman of the Committee, that it was apparently necessary to make a small additional charge for fittings; but, considering the very low price of oil at the present time, an endeavour ought to be made to keep the price of gas quite as low in comparison. He did not see why one consumer should be treated differently from another; and he considered that all should be charged 3s. 2d. per 1000 cubic feet alike. He had nothing to say against the scheme on its merits, and would like to see it adopted by 2000 instead of 200 householders.

The TOWN CLERK said that really no preference was given to large consumers over small ones. Anyone going to the same expense as ordinary consumers in having the gas introduced to their houses would be charged 3s. 2d. per 1000 cubic feet.

Mr. HART suggested that the price to small consumers falling in with the scheme should be fixed at 3s. 4d., which he considered would leave an ample margin for fittings. He would like to see the scheme a success; and to bring that about, it must be clearly shown that the price would be equivalent to, if not much less than, that of oil.

Mr. PEARCE said he was rather inclined to agree with Mr. Hart. He thought that, if possible, the price ought to be reduced.

The ENGINEER said it must be borne in mind that the gas would be sold to small consumers by the 100 cubic feet, which would be 4½d. They could not very readily split it into 4½d. If they only charged 2d. more than the present prices, he was afraid the new departure would not pay. A separate account would be kept for the extra 7d. charged; and if at the end of twelve months it was found that they charged a little more than was requisite, a reduction would be allowed. The Chairman of the Committee was anxious that the scheme should pay itself. If the price was fixed at 3s. 4d., this would only be a difference of 2d. per 1000 feet to the consumers, which would mean very little to them, but a great deal to the Gas Committee.

Alderman TURPIN was somewhat dubious as to the working of the scheme, although he said he would like something of the kind brought to a successful issue. They had paid an enormous sum for the gas-works; and he deprecated embarking on anything uncertain in gas supply. The scheme might work well in an inland town; but he was afraid it would not do so in a seaport town, where the people were in a house one day and away the next. There were a great number of small houses where it was a common thing to tamper with such things as gas-fittings.

Mr. HART said he gave the scheme his hearty support, but was prepared to move that the price to be charged should be 3s. 4d. per 1000 feet.

Mr. PEARCE suggested that, to make the scheme a success, a less sum than 3s. 9d. ought to be charged.

Alderman PYGOTT, in reply, said they only charged a price which they considered would pay for the extra outlay, and nothing would be spent on any house except at the distinct desire of the people themselves.

Alderman FROST was afraid that some landlords, who were called upon to pay so many things for their tenants, would be asked to pay this extra rate. The Corporation would have a great difficulty in getting their money.

The MAYOR said he did not think there could be any difficulty on that score, seeing that payment was to be in advance.

In answer to Mr. Poole, Mr. VALON stated that his calculations were based on an annual consumption of 10,000 cubic feet of gas.

Mr. LANDON said that, as a consumer of both gas and oil, he wished to state that he found gas equally as cheap as oil. In ordinary dwelling-houses, gas would be found much cheaper than, and in every way preferable to oil.

It was announced that, as soon as it was found practicable, a reduction would be allowed to small consumers; and the recommendations of the Committee were then unanimously adopted.

STAFFORD CORPORATION GAS AND WATER LOANS.

LOCAL GOVERNMENT BOARD INQUIRY.

On Thursday, the 4th inst., Mr. E. P. BURD, one of the Local Government Board Inspectors, held an inquiry at Stafford in regard to the position of the loans of the borough.

The following report on the subject by the Borough Accountant (Mr. G. T. Parker), which was submitted to the Town Council at their meeting the previous week, was first presented to the Inspector:—"By virtue of the Stafford Corporation Act, 1876, the Corporation were empowered to purchase the Stafford Gas-Works, and to provide water-works. The borrowing powers conferred by the Act were £25,000 for water-works, and for gas-works 'such sums as may be required for the purchase of the undertaking of the Gas Company.' The bond or mortgage debt of the Gas Company was made a first charge on the Gas Company's undertaking in the hands of the Corporation. This debt amounted to £4983 6s. 8d. Part of the consideration for the transfer of the gas-works was the grant of perpetual annuities to some of the shareholders of the Gas Company. The capitalized value of these at 4 per cent., or 25 years' purchase, is £14,150. By section 61, it is enacted that the Corporation shall, at the expiration of five years from the passing of the Act, make provision for the extinction of the annuities and of the bond or mortgage debt of the Gas Company, within sixty years from the passing of the Act, either by instalments or by means of a sinking fund. By section 99 it is enacted that the Corporation shall provide for the discharge, within sixty years from the passing of the Act, of all moneys borrowed for gas and water purposes, by the creation of sinking funds; and that after the expiration of five years from the passing of the Act, they shall annually set apart such sums as may be required for this purpose. The Corporation borrowed for gas purposes, in September, 1878, the sum of £55,000 from the Alliance Assurance Company, repayable by equal half-yearly instalments of principal and interest in thirty years; and for the balance required for the same purposes, they raised £3450 on debentures on the security of the district fund and general district rate. The obvious result would be that, in making so large a sum as £55,000 repayable in so short a period, a far heavier burden for loan charges would be borne by the present generation than was contemplated by the Act—that is, if the Corporation were also required to provide contemporaneously for the repayment of other loans. For the purpose of obtaining relief, negotiations took place with the Local Government Board; and, by arrangement with them, powers were obtained in the Stafford Corporation Act, 1880, for the amendment of the said section 99. By section 83 of the last-named Act, it is enacted that, in consideration of the above-mentioned arrangement for the repayment of the part of the moneys raised for gas purposes in thirty years, the provisions of the said section 99 be so amended that the Corporation may within sixty years from the passing of the Act of 1876, pay off by instalments moneys borrowed or to be borrowed under that Act for gas or water purposes, and that the creation of any sinking fund under section 99 of that Act may be postponed until such time as the Corporation may, with the consent of the Local Government Board, determine. Relying upon this clause, the Corporation have not made any provision for the extinction of the old mortgage debt of the Gas Company (£4983 6s. 8d.); nor for the value of the annuities (£14,150); nor for the other sums borrowed for gas and water purposes. But the Local Government Board, while admitting that the Corporation may in effect be reducing their capital obligations more rapidly than they are required to do have contended that their mode of procedure is technically wrong, and not in accordance with the Corporation's Acts. After a voluminous correspondence with the Local Government Board, extending over many years, the Board came to the determination that the relief required could only be obtained by the amendment of the financial clauses of the Acts of 1876 and 1880, by Provisional Order. They suggested for the consideration of the Corporation the terms of a Provisional Order which they had issued, relating to the district of Oldbury. Although requiring a revision of their existing Acts and Provisional Orders, the Corporation were not prepared to accept absolutely the Oldbury provisions; and at a Council meeting on the 30th of October, 1888, passed the following order:—'That the Local Government Board be requested to issue a further Provisional Order so as (as far as necessary) to extend the borrowing powers of the Corporation for water-works purposes, and also to revise the existing Acts and Provisional Orders affecting the Corporation, so that the whole of the water-

works loans may be placed on terms of repayment extending over the full periods provided by the Stafford Corporation Act, 1876, and the existing Provisional Orders; and that that Act and the Provisional Orders may be amended so as in effect to provide, with regard to all the loans of the Corporation, that so long as the Corporation, by extinction of their debentures or otherwise, shall annually (according to the basis of the prescribed sinking funds) reduce their capital obligations, they shall not be compellable to actually form sinking funds, and that any sinking funds which may have been formed may from time to time be applied in the extinction of Corporation loans, and that the Corporation may be enabled to reborrow from time to time any amounts which they may have previously paid off in excess of such amounts, as under the prescribed sinking funds they were compellable to do.' The inquiry about to be held is in consequence of this order of the Council." In regard to the water-works, the report states that the borrowing powers under the Act of 1876 amounted to £25,000; of which sum £15,000 was raised for the common scheme and for mains, &c. In 1885 these powers were withdrawn, except so far as already acted upon, and powers were granted to borrow £20,000 repayable in not more than sixty years, and in 1887 the powers were extended to £25,000; and the Local Government Board were authorized to extend the period for repayment of moneys borrowed under the previous Order—the maximum being sixty years. A sum of £7000 was raised for the Enson Moor scheme. The power unexercised was thus £18,000. The Surveyor's original estimate for the Milford scheme and the suburbs was £20,000; or £2000 more. For the £7000 the period of repayment prescribed by the Local Government Board was only ten years; and for the sums to be raised for the Milford scheme only thirty years. But "the Corporation may," the report continues, "with confidence ask that the period of repayment should, as regards all the water-works loans, be based upon the 60 years' limit authorized by Parliament to the Corporation. The ultimate capital expenditure will be comparatively moderate; and the interest alone, upon the unproductive loans already raised, has been a heavy burden for some years past. . . . The remaining part of the Council's Order applies to the method of repayment of all the loans of the Corporation. The capital obligations for gas purposes are: Old gas company's bonds, £4983 6s. 8d.; perpetual annuities capitalized at £14,150; mortgages, £55,000; debentures, £3450—altogether £77,583 6s. 8d.; debentures (raised in 1882, for extension of works, &c.), £10,000—total, £87,583 6s. 8d. The loans for water purposes are: Debentures (Common site and mains), £5000 (raised in 1877) and £10,000 (raised in 1877-8); and debentures (Enson Moor scheme), £7000 (raised in 1887)—total, £22,000. Summary: Gas, £87,583 6s. 8d.; water, £22,000—total, £109,583 6s. 8d. The amounts which should be in the several sinking funds in the present year (calculated upon a 3 per cent. basis), under provisions similar to those of the Oldbury Order are: Gas, £5522 1s.; and water, £1111 3s. 5d.—total, £6693 4s. 5d. The amount actually repaid on account of the gas loan of £55,000, to the 4th of March, 1889, has been, however, £12,062 15s. 11d., being £5369 11s. 6d. in excess of the requisite sinking funds for the repayment of all the present loans for gas and water. Thus besides the sum appropriated from the gas-works funds for the water sinking fund—viz., a£1111 3s. 5d.—the sum of £5369 11s. 6d., which would otherwise have been vailable for the relief of the rates, has been paid in excess of the necessary rovision for the extinction of the gas loans in the prescribed periods. As remedy for this state of things, it is proposed to obtain powers by Provisional Order to reborrow from time to time any such sums that may have been repaid in excess. The moneys so reborrowed will doubtless be mainly applied in relieving the rates of the heavy charges of the next few years in respect of the water-works loans, and of the extraordinary loan charges of the coming year, consequent upon the reorganization of the system of repayment hereafter mentioned. It will be noticed that, in their Order, the Corporation ask that they may not be compelled to form sinking funds so long as they shall annually (according to the basis of the prescribed sinking funds) reduce their capital obligations. To obviate the necessity for this, it is proposed to prepare and submit to the Local Government Board for their approval, a schedule for each loan, showing the amount which should be in the prescribed sinking fund at the end of each year of the period for its repayment. This applies not only to the gas and water loans, but to the other loans, which I have now to bring under your notice."

The Town Clerk (Mr. M. F. Blakiston) said there was no difference of opinion as to two of the matters on which he had to speak—the application that they might have the longest possible period of repayment for the water-works loans, and that they should have permission to legally carry out a scheme they had acted upon, of extinguishing each year their capital obligations to the amount of what would otherwise have been provided for a sinking fund; thereby avoiding any loss of interest. As to the third proposal—the reborrowing of money—there was a difference of opinion. The technical majority of the Council held that they ought to consider the Corporation as a whole, and not departmentally; the technical minority thought the Gas Department should be treated exceptionally, because it was subject to commercial depreciation, and to risks even beyond ordinary commercial risks, as to the continued use of gas. He contended that the circumstances of the Corporation justified the present application; and he went on to explain the circumstances under which the Corporation, although entitled by the Act of 1876 to borrow for sixty years, found themselves compelled to accept thirty years from the Alliance Insurance Company. They then represented to the Local Government Board that while they were paying off the £55,000 in thirty years, they should not have to be paying off a further sum of £55,000 until the expiration of that time. The Local Government Board admitted the reasonableness of the proposition; and a clause was incorporated in the Corporation's Act of 1880 to enable the arrangement to be effected, but it had never been done. They now asked that this arrangement should be made clear, and fully sanctioned by the Local Government Board; the sum total of gas and water loans in fact amounting to only some £400 of the £110,000 indicated. A sum of £22,000 was for water-works; and of this £7000 was at present only sanctioned for ten years. But the Local Government Board had specially taken power to revise this. The latest sanction for £13,000 additional was only for 30 years; and the Board had intimated that a further sanction would be for a shorter term than that. He hoped to show that, even in the case of machinery, the full term of 30 years should be granted for all these loans. Although this was contrary to the general policy of the Public Acts, the Legislature had recorded the conviction that any money the Stafford Corporation might require for gas or water purposes, need not be repaid for sixty years. He contended that in their case no difference should be made between loans for machinery and anything else. With regard to reborrowing, he maintained, on the figures given in the Accountant's report, that £5369 had in one form or another been paid in excess by the ratepayers for the benefit of posterity, which was already pretty well cared for. He thought that they ought to be allowed to reborrow, as in the case of the Oldbury Order.

The Inspector said that as a matter of fact the Oldbury people had never repaid the money. They had simply overdrawn at their bankers; and the Local Government Board, it would be remembered, had to come to their relief.

The Town Clerk pointed out that the reorganization scheme would involve in the first year an addition to the rates of £423; and it was hoped the reborrowing powers might be prayed in aid. He then entered into a history of the water-works loans; showing that £22,000 had been expended out of powers amounting to £40,000; and that as the present scheme was for £25,000, further powers to the amount of £7000 were needed.

Mr. W. Blackshaw stated that the requirements of the present population would not exceed a quarter of a million gallons a day at present; but there was water and machinery to supply a million when it was required. The only additional thing which would be needed in that case would be another reservoir, costing £2500, and mains as soon as the area increased.

Alderman Joyce said the experience they had bought had been of benefit, because it had taught them where they could not go for water; and they had been directed to the present site, where they had a scheme of very moderate cost. Of the £25,000 they asked for, £5000 was for purposes outside the borough, and would not be used unless they were sure of profit. The water-works would in time become a valuable property; but as the Corporation would not put pressure on the owners and occupiers of property unless they saw it was for their interest, for some years the works could not bring in anything like their real value. He hoped, therefore, that not only would sixty years be allowed, but that, in order that they might not at first have to apply for increased capital for working expenses, repayment might be deferred for five years.

The Inspector remarked that the question had been argued again and again; and the Local Government Board had always opposed the idea. It would be of no use for him to report upon it.

Alderman Dudley said his duty was clearly to oppose the application so far as reborrowing powers were concerned. He did so as a large ratepayer, a large gas consumer, a member of the Corporation, and the Chairman of the Gas Committee; and he was strengthened by a resolution of that Committee condemning the proposal as prejudicial to the interests of the department. The works were intended to supply the inhabitants with light at a reasonable rate, and not to make the profits support the other departments of the Corporation. He quoted the Oldham case, in which outside consumers were charged 2d. per 1000 cubic feet more than the ratepayers; and large sums were handed from the profits to the relief of the rates. The preferential rates were afterwards ordered by Parliament to be discontinued; and the Gas Department was only allowed to make 6 per cent. profit. The circumstances of Oldham were to a considerable extent on all fours with those of Stafford. With regard to the decision of the Council, the fact was that at a meeting of the Finance Committee it was decided, by all except the Chairman, that the proposal to reborrow should be withdrawn. On the same day the Council meeting was held, and several members of the Committee did not attend, thinking it would be merely formal to confirm the Committee's action. The Chairman of the Committee, however, continued his opposition, and carried his point by ten votes to seven—ten being only one-third of the Council. He contended they acted wisely in repaying the £55,000 in thirty years; so large a proportion being for goodwill, which had no monetary value. They had reduced the liability of the ratepayers to the extent of the excess; and they had secured a nominal reserve fund to fall back on in emergencies. Since he became Chairman of the Gas Committee, it had been their policy that no more capital should be borrowed; £10,000 having been borrowed shortly before for no legitimate reason. It had been their rule to keep their profits within certain limits by sharing them with the consumer. To hand the profits of the gas-works over to other departments, would be inimical to their interest in this respect. Last year they paid £3278 for interest on capital; sinking fund, £1334; reduction of district rates, £1350; depreciation of plant, £856—total, £6818. But if they were restricted, as in the Oldham case, to 6 per cent., they would have handed over nothing to the rates, and would have to find £400 from somewhere. Before he became Chairman in 1883, £1000 a year was applied to the rates. Since then the following sums had been handed over to the benefit of the town:—In 1884, £1500, and the price of gas was reduced 3d. per 1000 cubic feet; in 1885, £2220; in 1886, £1580, and the price of gas was reduced 3d.; in 1887, £1250; and in 1888, £1350. In about a month's time, when he made his annual statement, he hoped to announce that they would not only be able to dispose of a larger amount than they had for some time past; but also to make a further reduction in the price of gas. He contended that the Committee had acted on equitable lines. Though the ratepayers had not had to pay a penny, as they had become security for the money it was right they should reap some advantage. On the other hand, they had to consider the consumer also, and to avoid by legitimate means the competition of electricity, cheap oils, or water gas. Even if they had been paying on the sixty years' basis, a large part of the increased profits must have gone to the consumer and not to the relief of rates.

Mr. Peach asked the Inspector whether the gas-works would be affected by the proposed reborrowing.

The Inspector said he could not give an opinion off-hand; but if they reborrowed, it would be difficult to say whether it was on account of gas or anything else. He was also understood to say that if the Corporation were found to have made default in setting aside money for repaying the water loans, it would be a question whether the Local Government Board should make the Corporation set aside double the amount for the future, to make up the deficiency.

A vote of thanks was passed to the Inspector, and the inquiry closed.

Dundee Corporation Water-Works.—In view of the formal "opening" on the 1st prox. of the new Lintrathen main by Mrs. Hunter, the wife of the Lord Provost, it may be interesting to give a few particulars respecting the Dundee Water-Works. There are now five impounding and six service reservoirs, having an aggregate area of 612¼ acres, and a storeage capacity of 2350 million gallons; and something like 200 miles of pipes and aqueducts—supply being given and taken in three counties. The capabilities of Monikie and Lintrathen for the production of water for town use, supposing all the water in both cases could be impounded, may be set down as 2 million gallons per day from Monikie, and 20 million gallons per day from Lintrathen. The average daily consumption of water in 1873 was under 3 million gallons. It is now almost 9 million gallons; the population supplied numbering nearly 200,000. In order to keep abreast of this enormous increase, many miles of new and enlarged mains have during recent years been laid down. In point of fact, since 1873 the system of distribution has been greatly changed; and the division of the town and surrounding water supply districts into "zones of supply" has ensured those living in the middle and higher parts a supply in continuity, abundance, and pressure equal to that of the lower portions of the city. Including the cost of the Lintrathen extension (about £60,000), the Water Commissioners own works for which they have paid £810,000. The Commissioners have been fortunate in their last undertaking. Corresponding works in 1873 cost above £100,000; the difference in the cost of iron alone amounting to nearly £40,000.

ELECTRIC LIGHTING IN THE METROPOLIS.

BOARD OF TRADE INQUIRY.

(*Before Major* MARINDIN, C.M.G., R.E., *assisted by Captain* CARDEW.)

FOURTH DAY—SATURDAY, APRIL 6.

Mr. CRIPPS to-day opened the case on behalf the Metropolitan Electric Supply Company, Limited. He said that it appeared to him that, in regard to the Company he represented, there were two points which could be easily established to the satisfaction of the Inspector and the Board of Trade. The first of these points would be that the Metropolitan Company were in a thoroughly sound financial position; and had ample capital for the work they proposed to undertake. The other point he would like to make clear was that the system proposed to be adopted by the Company was the best and the safest method of electric lighting; and that from an economical point of view, it would stand well in comparison with that of any other system. As regarded the safety and convenience of the workers, it was in the best possible position. Their system was a satisfactory and a safe one from every point of view; and they did not fear competition in that way, but would stand upon the strength of their own case, and were perfectly satisfied that their position would enable them to stand favourably before the public. The capital of the Metropolitan Electric Supply Company was £500,000, divided into 50,000 shares of £10 each. When the prospectus was issued, the amount was subscribed more than twice over. There were upwards of 700 shareholders on the register; and £3 per share had been called up. They had spent over £40,000 on their Whitehall station; and when any further expenditure was necessary in order to carry out the obligation which the Company had undertaken, there would be no difficulty whatever in finding amply sufficient financial support. The districts which they proposed to include for the purpose of electric lighting were comprised in the first instance under four Provisional Orders. As regarded one of them—the North of London—after careful consideration, the Company did not propose in the present inquiry to ask for any compulsory powers at all. In fact, so far as that Order was concerned, they had withdrawn from the application. The first Order upon which they would ask to be sanctioned was the Mid London Order, and according to that the area to be supplied included the City of London and the liberties thereof; St. John the Evangelist, Westminster; St. Margaret's, Westminster; St. George's, Hanover Square; St. Giles's in the Fields; St. George's, Bloomsbury; St. Andrew, Holborn-above-Bar; St. George the Martyr; St. Sepulchure; Saffron Hill; Hatton Garden; Ely Rents and Place; St. Ann's, Soho; St. Paul, Covent Garden; St. John the Baptist, Savoy; St. Mary Le Strand; St. Clement Danes; the Liberty of the Rolls as well as the Charterhouse; Gray's Inn; Lincoln's Inn; Staple Inn; Furnival's Inn; and the collegiate Church of St. Peter. The next was the South London Order, and that comprised the district of Lambeth; Christ Church; St. Saviour; and Clapham. The West London Order comprised St. Marylebone and Paddington. In order to supply electricity to these districts, the Company proposed to have certain central or generating stations. They had made provision as regarded a certain number of stations; and he would give the names, situation, and capacity in respect to lighting power. They had at present a station at Whitehall with a capacity of 12,000 lights. They had arranged for a station at Sardinia Street with a capacity of 50,000 lights; at Rathbone Place, with 24,000 lights; at Manchester Square, with 50,000 lights; at Eccleston Place, with 40,000 lights; and at Waterloo Bridge, with 20,000 lights. This was the present capacity of the plant they proposed for these stations.

Major MARINDIN: Are all those arranged for?

Mr. CRIPPS: Yes, they are all arranged for. The limit of the capacity of these stations, he said, could be increased if required; and at Eccleston Place it could be increased from 40,000 to a capacity of 150,000 lights. The Waterloo Bridge station could be increased from 20,000 to 75,000 lights. The Whitehall station was running at the present time. The Sardinia Street station would be ready in June; and the Rathbone Place station would also be ready in that month—in fact, some of it was now running. The Manchester Square station would be ready in July; the Eccleston Place station in August; and the Waterloo Bridge wharf in September. With reference to the City, the undertakers had made certain arrangements. They had purchased a wharf known as Greenmore Wharf, so that they had a centre there capable of supplying the City district. The wharf adjoined Southwark Bridge. At present they had not done anything with regard to the plant; but such arrangements were made that the wharf would be capable of carrying plant, when they got it, to the capacity of 120,000 lights. As to the proposed system of the Company, it had advantages; and it was suggested that it had some disadvantages. Whitehall had been supplying a very compact district; and it was worked by the direct system of storeage batteries. The pressure throughout the district would be 100 volts; and in the engine-rooms between 100 and 110. There would be no transformers and no transformation. The other stations would be worked on the alternating current transformation system, converted by connecting mains into a low pressure. The pressure in the mains would not exceed 1000 volts; and in the houses from 50 to 100 volts as the customer might require. The stations would be from one to two miles apart, and of sufficient size to fully utilize the staff employed; and therefore there would be an economy of labour by the size of the various generating stations. The system they proposed had been carried out in Berlin, St. Petersburg, and America; and it had proved a most efficient system. It had been suggested by Mr. Pember on behalf of the Corporation he represented, that they hoped to have at Deptford a station analogous to the Beckton Gas-Works; but he (Mr. Cripps) could not see how they could compare with the Gas Company's system. Whatever the advantages to the Corporation of going to Deptford were, there was no analogy in their operations to those of the Gas Company in having a supply in London or out of London. As regarded the gas undertakings, the great difficulty in having their premises in populous places was because of the noxious vapours and gases which were given off in the manufacture of gas, and more particularly in the manufacture of residual products. And so much had this been felt, that wherever powers were taken for the actual manufacture of gas, the Standing Orders of Parliament provided that everyone within 300 yards had a right to be heard in the matter. There was no such difficulty as that in regard to the production of electricity. In respect to noxious gases and such matters, it might be expedient to move the gas manufactory out of London; but there was no analogy with regard to the various electric lighting centres. A suggestion had been made as to the cost of coal; and it was sufficient for him to deny that there would be any such advantage as that which was claimed by the Corporation, who in that respect were not in any better position than the Metropolitan Company. Counsel then proceeded to deal with the question of noise, vibration, and nuisance alleged to be caused by having the generating stations in populous places; and afterwards dealt with the form of the various Orders of his Company, in which he said there had been some variations from the originals.

Major MARINDIN: Do the three Orders of yours all agree?

Mr. CRIPPS: Yes; but there have been one or two minor alterations. Counsel then went on to say that the undertakers did not desire to have a monopoly; for they believed that their system was the most efficient, and could be so relied upon that they would get the custom. They did not propose to take compulsory powers as to any private property; and as to the railways, there would be no difficulty in framing a protective clause. With the Thames Conservancy, they had arranged to meet the difficulty by inserting a special clause. He then specified the various local authorities and other bodies who opposed the Order; and in doing so said that the local authorities had raised the question of overhead wires. The undertakers, however, had satisfied themselves that under the public Act they would have no power to place overhead wires to their mains; and they did not seek for any special powers in that respect. But in order that the matter might be quite clear, they did not object to introduce this provision:—"Provided that nothing in this Order shall authorize the undertakers to place any electric line above ground along, over, or across any street without the express consent of the local authority." As a condition precedent to getting any powers, they would satisfy the Board of Trade as to their financial position; and that they had power to carry out the works they undertook to do. Some of the objectors had asked that the period of 42 years should be reduced to 24; but on that he was absolutely at issue with them. He considered the matter was dealt with and settled, as regarded the limit of time, by the Act of 1888, the gist of which was the alteration of the period from 21 to 42 years; so that they stood on the general law, and should not make any concession. Some objectors, too, had raised the question as to the time within which the supply should be given. A modification had been made; and the undertakers considered that eighteen months would be a reasonable limit. Another matter was the size of the area over which they were asking power to work; and they believed it would be more economical, and better in every respect, to have a large area than a small one for a Company like theirs with a large capital. It would be better for local authorities, consumers, and Company.

Sir *John Pember*, examined by Mr. LITTLETON, said he was Chairman of the Eastern Telegraph Company and other Telegraph Companies, and was also Chairman of the Metropolitan Electric Supply Company. That Company had an authorized capital of £500,000, divided into 50,000 shares of £10 each. In August last subscriptions were invited, with the result that 43,900 ordinary shares were very soon applied for. There was a large amount over-subscribed. There were upwards of 700 shareholders on the register; and £3 per share had been called up. A sum of £40,211 had been spent upon their Whitehall station, which was taken on the formation of the Company. The Company had in addition acquired the working station at Rathbone Place; and stations were in course of erection in Sardinia Street, Manchester Square, Eccleston Place, and Waterloo Bridge. To establish these stations, the Company would have to spend about £351,000 out of £500,000. This would leave a large margin for working capital and moderate extensions if required. He should not consider the Company a great success unless they quadrupled their present capital. There would be no difficulty in finding the money if their present installations gave the returns that were expected from them.

In cross-examination by Mr. PEMBER, witness said he had no objection to wholesome competition of electric lighting companies.

Mr. WRIGHT: What view do you take as to the relations which the different electric lighting companies promoting Orders ought to have to each other within the Metropolitan area.

Witness: I think the object of all the parties promoting Orders should be to make the light as satisfactory as possible to the public as well as to the shareholders. Therefore if there can be any friendly combination—I do not mean a joint purse—between them which will facilitate the making of additional light more quickly and more efficiently, the companies should endeavour to do so as far as lies in their power. The great object is to obtain for the public the cheapest light that is possible, consistent with a fair return to the shareholders.

You would hardly be of opinion that electric lighting has so far advanced that it is possible to say with certainty which system is the best?—Electricity is just in the position that any day we may see wonderful results which would develop and cheapen the system.

Cross-examination continued: His Company were not bound to any particular system. They took up that which they believed to be the best suited for the locality in which they were going to establish their installation. They had determined upon a system for their mains, and had contracted for installations in different places.

Mr. WRIGHT: Do you think that in the long run the system most advantageous to the public would be that in the first instance particular districts should be assigned to different companies working on different systems, and that they should invade at their own free will every part of the Metropolis at the same time?

Witness: My idea is that if I wanted to be a monopolist, I should like to have a district to myself. But if I were a consumer of electricity, I should prefer to have two or more in each district. Those who do the work best are sure to get the custom.

Do you mean it is desirable in the interests of the public in any particular district that three or four companies should at the same time lay their mains in the same streets, and supply different systems. I do not think it is likely that three or four companies would go into a place where there was not sufficient work for them.

But it is your view that that is the best system?—Yes.

Would not that make it a contest between a few large companies as to which had the longest purse?—The longest purse would soon get emptied if the company were dealing in that which was not acceptable to the public. The company which brings the greatest amount of practical knowledge to bear on the subject is the one which is most likely to be successful. My Company has power under its Articles to increase its capital indefinitely.

Have you any power under your Articles of Association to sell electric light?—The Company is formed to supply it.

But have you taken an opinion upon that point?—I think no opinion is necessary; for we are established to supply the public with the light.

In further cross-examination, witness said there was no finer field in the world for electric lighting than London. Their present capital would be sufficient to light the whole of the districts over which the Company sought powers. They had calculated that certain districts would require a certain amount of light; and their capital would do that and leave a large margin. But if they found that in the districts the demand was in excess of that which they were able to supply, they could call up debentures, so that they would have capital sufficient to supply every street requiring light. They could call up by borrowing an equal amount to their present capital; and that would make £1,000,000 altogether. This he certainly thought would be sufficient to light the whole of the streets within the area of their Orders.

Mr. GRIFFITHS: Have you considered whether, if you had to light the whole of your area satisfactorily, you would have to increase your works greatly?

Witness: I believe that the stations we have secured would amply supply the districts we have taken up.

Mr. WILKIN: Will your Company lay themselves out to supply electricity for power?

Witness: As soon as we have done our lighting work sufficiently, we will turn our attention to power; and we believe we shall eventually get as much out of the power as out of the light. That is the intention of the Company, for it is specially mentioned in the prospectus.

Mr. *J. E. H. Gordon*, examined by Mr. CRIPPS, said he had charge of the design and erection of the Company's several stations. The Whitehall station was intended for a large compact district in which there were a number of hotels. That station would be worked by direct current and storeage batteries. The pressure in the engine-room would be from 110 to 116 volts. The dynamos were driven direct by an engine of 200-horse power. There had not been the slightest difficulty at that station, either as to noise, smoke, or vibration. At the other stations they had adopted the alternating current transformer system as being suited to large areas. The pressure on the mains in that system would be 1000 volts; and this was perfectly safe. The number of volts supplied to the customers would be from 50 to 1000. Having explained the work at the different stations, the witness said there was nothing experimental in what the Company proposed to do. It was well within the limits of practice. The cables would all be underground; and the supply to the houses would but very slightly disturb the pavement. They had laid a main across West Strand and Trafalgar Square; and there was no appreciable disturbance of the traffic. There were allegations about a nuisance from their works at Paddington; and some persons said they were annoyed by clouds of dirty steam. One man swore the electricity turned the meat in his cellar sour (Laughter). But those complaints were not now made, as the nuisance had been obviated.

In cross-examination by Mr. PEMBER, witness said that the coal for their stations would be landed at their wharves, and then carted to the stations. If they supplied the whole of their district, and did the business they hoped, they would have to increase the number of their stations from six to eighteen. The consumption of coal would be about 150,000 tons.

Mr. PEMBER: Is there any physical difficulty in your Company arranging with any Company to have a joint laying of mains?

Witness: I should think not.

In answer to Mr. SHIRESS WILL, witness stated that the Company desired to adopt the experience on electric matters of all countries. The American system was to divide the producing plant into six, eight, or ten units; so that if there was a breakdown it would be to the smallest possible extent. This was a very different plan to the one proposed at Deptford; and he considered much preferable, both in regard to safety and economical working.

Replying to Mr. WALLACE, witness said that the plant of Eccleston Place station would supply 50,000 lights; but by the purchase of an adjoining site, which the Company had the option of taking, they could greatly increase the supply. The Company proposed to light only a small portion of St. Margaret's, Westminster, from that station. At present no arrangements had been made to light the remaining portion of Westminster. There was no great difficulty either in repairing the mains or in connecting the light to the houses.

In reply to Mr. GRIFFITHS, witness said that every 200 yards there would be a testing-box flush with the pavement. The junction-box would be buried under the pavement. Every two houses must have a junction-box. If there was not room under the pavement, they would have to go into the roadway; and they might have to use iron covers under the horse-way, as had been done in Trafalgar Square. He did not know the number of sewers and works underground in the City; but although he had not specially considered the matter, he thought they could find room for their mains to be laid there. If there was not room for the tubes, of course it could not be done.

Mr. GRIFFITHS: Have you considered how deep you will have to go, to prevent breakage?

Witness: About as deep as the gas or water pipes.

How deep is that?—I think it varies from 6 inches to 2 feet. Witness added that all their cables would be underground; and they would have no overhead wires. The Greenmore Wharf, Bankside, near Southwark Bridge, was about ¼ to ½ acre.

How many lights do you propose to have for the City area?—As many as we get orders for.

What is your ability to supply?—I think from the Greenmore Wharf alone, we can give 150,000 lights. To do that the engines would be 200-horse power; and he should advise a plant of ten such engines to begin with, so as to allow for extension. Protection against fire was of course necessary, but there was no danger. If because they used transformers the insurance companies increased the premium, they would have to build chambers.

In answer to Mr. YOUNG, witness said he saw no objection to giving notice to the local authorities when repairs had to be done.

Mr. YOUNG: We suggest that there should be testing-stations provided in a similar manner as is done under the Gas Acts, and that the local authority should appoint the tester and fix the testing-stations.

Major MARINDIN: These are points which must be left to the Board of Trade.

Mr. HORTON (Paddington): Do you contemplate lighting the whole of the street lamps?

Witness: It depends whether we can get the price from you.

What is the cost?—That rests upon the number of candles-light you want. Witness added that he had no idea of the number or length of the streets in Paddington. He had not considered the details of the subject.

Mr. *John Hopkinson*, F.R.S., examined by Mr. LITTLETON, said that the system of the Metropolitan Electric Supply Company was one with many stations; and thus differed from the system of the London Electric Supply Corporation. It also differed in the number of machines to be employed. The system described the previous day was one with a small number of large machines; whereas theirs was one with a large number of moderate-sized machines. Their distribution of electricity, too, would be more uniform. They would obtain uniformity of tension by supplying it of high potential. That system could be better adapted to consumption. Every transformer meant a certain loss of power. He did not expect any danger arising from the system employed by the Metropolitan Company; and any nuisance there might have been could be got rid of by modern machinery.

Cross-examined by Mr. WALLACE, witness gave his experience of central stations where accumulators had worked—at Vienna; and, in answer to Mr. GRIFFITHS, said that by the arrangements he (witness) proposed, there would be no disturbance of the telegraph or telephonic communication by the Company's electric current.

Dr. *Fleming* recalled and cross-examined by Mr. MOULTON, Q.C., said his chief experience was in the manufacture of lamps; and he had given attention to inquiring into the life of the lamp. He did not know that there was anything in the alternating current *per se* which would shorten the life of the lamp. The even supply from the storeage battery would give a longer life. He had expressed the opinion that the transformer as at present used would shorten the lamp's life. There would be some difficulty in getting uniformity of life. The price of a 20-candle lamp to the public was now about 5*s*. The fair average limit to the useful life of a lamp was about 1000 hours. In the United States when he was there, the direct system of electricity was that which was chiefly used, and the alternating transformer system had not then come much to the front. The application of the transformer in the United States was to large areas rather than straggling districts. The nature of the transformer system was such as to make it suitable for a straggling area. He had thoroughly gone into the merits of the Edison direct supply in New York in 1884 or 1885. It was then doing a very large business. In that system a large number of dynamos poured into a common network of mains. No breakdown of a dynamo would affect the network. The use of alternating currents from big dynamos did not render it impossible to pour into the same network of mains from two different machines. It had been done. The joints in underground conductors of electricity were no more weak points than were the joints of pipes. They did not present much greater difficulty; but, of course, care and skill had to be exercised.

By Mr. PEMBER: He had no reason to believe that the alternating current *per se* reduced the life of a lamp, unless there was a variation in the sources of supply. The transformer system of supply had been in use in America about equally with the direct system. The consumers would not be put to any extra expense by the use of the transformer than by the storeage system. There was no reason why the transformer system should not be used in lighting populous areas. It had the advantage of long reach. There was some difficulty in insulating joint pieces; but nothing beyond that which could be overcome by care. As a matter of fact, lamps lived much more than 1000 hours. He had known some lamps which had lived 7000 or 8000 hours

Mr. MOULTON: With a battery?

Witness: I do not know.

Dr. *Hopkinson*, recalled, and cross-examined by Mr. MOULTON, stated that a variation in the voltage supplied to lamps put to a great strain caused a reduction in the life of the lamp. He agreed that it was important that the generating unit should be small compared with the total generating power employed in the network. There were many advantages in that, both as to safety and economy. This was important in a close network supplying a number of houses.

By Mr. CRIPPS: The advantages of having a small generating unit could be obtained by the system of the Metropolitan Company. There was no difficulty with a pressure of 1000 volts.

Mr. *A. Walton*, examined by Mr. LITTLETON, said he was Manager of the electric light works of the Great Western Railway Company at Paddington. There had been no complaint received there during the last two-and-a-half years.

Cross-examined by Mr. PEMBER: There was an alteration in the construction of the machines made in order to prevent the nuisance of which complaint was made. The nuisance was the humming noise of the dynamos. There was also a little nuisance from smoke; and to prevent that, they had a special form of fire-box.

Mr. PEMBER: How many lights do you give from there?

Witness: About 4000 candle incandescent lamps and 100 arcs.

Mr. *Thomas Spencer*, Electrical Engineer of the Westinghouse Company of America, in answer to Mr. CRIPPS, said he had supervised the erection of a large number of stations in various parts of America supplying in the aggregate about 400,000 lights of 10-candle power. The system which the Westinghouse Company preferred to adopt was the transformer—the system which the Metropolitan Company were now proposing to carry out in London. As the result of experience, the Westinghouse Company had adopted a pressure of 1000 volts, as there was some difficulty with a higher pressure. The 1000-volt pressure was considered best having regard to both light and safety.

Professor *George Forbes*, examined by Mr. CRIPPS, said that in his opinion the system of the Metropolitan Electric Supply Company was the best that, with their present knowledge, could be adopted. After going into details as to the amount and effect of pressure upon the different systems of electric lighting, he said that from every point of view the arrangements of the Metropolitan Electric Supply Company were those best calculated to give a perfectly uniform distribution of pressure to the lamps all over. That, next to economy, was the most important point in distributing electricity. Their system was certainly economical. It was of the utmost importance to have central stations overlapping one another, so as to supply districts from another centre by another current. The subdivision of power into several engines was an economical plan. As the result of considerable experience gained from inquiries in America, he had come to the conclusion that the system which the Metropolitan Electric Supply Company were adopting was the most satisfactory. What he had seen at work in America and at Rome, Milan, and other places on the Continent, had proved to him that the Metropolitan Electric Supply Company's system was the most efficient and satisfactory. The battery system was very little used in America; but the transformer system was making rapid strides. The battery system had not, he thought, so far proved a commercial success. The cost of the batteries was so great that he did not see how it was possible to make that system work economically. Besides the great cost, there was considerable loss in the battery system.

By Mr. PEMBER: There was a proposal which had been alive for years to bring electricity from Tivoli to Rome along trunk mains. He would not say that batteries would last more than four years; but there was no evidence of any batteries having lasted more than four years.

FIFTH DAY—MONDAY, APRIL 8.

The proceedings opened with the cross-examination of Professor *Forbes*, by Mr. MOULTON. Witness stated that the system the Metropolitan Electric Supply Company intended to use was a transformer system with 1000 volts pressure in the distributing mains; and each distributing main was connected with a generating source. He preferred that, whilst in action, the connection should be with only one generating source. Of course, that was not the only method which had been adopted. The alternating currents used in distributing mains connected with more than one generating source had been in practice at Rome, and also in America; but the preference in the latter country was given to a subdivision of mains as much as possible, and that was what he proposed. The proper pressure he believed was 1000 volts in the distributing main; and he arrived at his conclusion as to this about a year and a half ago when travelling in America. When on the Continent, he saw several methods of distribution; but the main one was that of the direct supply. It was very expensive; but it worked very well. With the exception of the extra cost in the mains, there was no element of greater expense than in the transformer system; but in the way in which it had been used, he believed it was more expensive. He had gone into the question of expense of lighting by electricity at Paddington; and it seemed to him that the lighting by the battery system was at present prohibitive. The cost of mains in the accumulator system was much the same as in the direct supply. The accumulator system prevented the light being suddenly extinguished. There was a storeage of energy in it which did not exist in the direct supply system.

In reply to Mr. SHIRESS WILL, witness said there was no storeage system in use in Berlin; the direct supply was in use there.

Cross-examined by Mr. GRIFFITHS, witness stated that the systems of electricity at Rome and at Milan were different. There was a great deal of private lighting in Rome; and he believed there were 6000 or 7000 lights of 16-candle power. At present there was no public lighting there at all. He did not know what was the cost of the supply there; but it was considerably higher than the figure stated for London. The largest engine in use at Rome was 400-horse power, and at Berlin 600-horse power. The system at Milan was a mixed one. They had an alternating current for lighting up some places; and in the two large theatres, there was a continuous current. Some of the arc lamps were lighted with the alternating current; but most of them were used with a direct current. The same generating-stations were used; but there were separate engines and dynamos. The station at Milan had 14,000 incandescent lamps of 16-candle power; and there was a service of 310 arc lamps in the streets. There were overhead wires for the arc lamps. If he had to light a large place like Winchester House, occupied with separate tenants, he should prefer to have more than one transformer. Most of the transformers were made in fire-proof boxes with a cast-iron outside. In Rome the mains were carried under the surface; and he believed that they were under the footway.

Cross-examination continued by Mr. MOULTON: He had drawn up a report as to the subject of electric lighting in the parish of Paddington; and in that report he stated that, although he had said that 16,000 incandescent lamps of 16-candle power were enough to start upon, the fact must be realized that the cost of production and the cost to the consumer would be reduced by an addition to the number. The reason was that expenses must be incurred in the first instance with the 16,000 lamps; but with the same kind of machinery and without any proportionate addition to capital, they could very largely increase the number of lights. He was of opinion that for this increase of light it would be cheaper to put down storeage batteries, and charge them by direct current than to put down alternating mains and supply direct. That was advisable for several reasons. Whilst it would give a large output, there would be very little additional expense. He had made a proposal to the Paddington authorities by which they would be able to burn the refuse from their dustbins by properly designed furnaces, in order to get up steam; but there was some difficulty, because it would go on during the daytime, and his proposal was to remedy that, and to burn the refuse day and night.

Mr. LOYD stated that the Company he represented were preparing to adopt the suggestion of Professor Forbes as to the burning of refuse.

In reply to Captain CARDEW, witness stated that one of the reasons why the price of electricity at Rome was so high was because the coal there was dear. The fact that a central main was being used would not increase the danger of making a connection to the houses.

In answer to Mr. LITTLETON, witness said that in the best battery the storeage would be sufficient to keep the lighting going on for some hours —perhaps for eight or ten hours—even if the engines broke down, for there would be sufficient storeage in the secondary battery.

Mr. *Siemens*, Vice-President of the Institute of Electrical Engineers, was then examined by Mr. C. A. CRIPPS, and stated that he had had great experience in fitting up electric installations both in London and on the Continent. He had seen the stations at Berlin, St. Petersburg, Moscow, Darmstadt, Munich, and other places. At Berlin the system adopted was the same as that of the Metropolitan Electric Supply Company—there was a series of central stations; and on the whole it had been found to work well, and was being extended. The system at St. Petersburg was simply a central station with three conductors; there was a direct current. At Moscow, the system was the same. At St. Petersburg, at first the electric lighting was started from large barges, which were moored along the quays, so as to have central stations as near the lighting as possible; but since then it had been brought near the place where the lights were used. At Darmstadt, where the work was just beginning, they had a system of batteries; but they were employed in a totally different manner to the Electric Power Storeage mode. Although he rather believed in the system at Darmstadt, which was a modification of that of Berlin, he thought, considering the great distance to be traversed, the transformer system would be the best for London, with a number of central stations for generating the current. He had made experiments at his own place with machinery with a pressure of 10,000 volts, and had used a pressure of as much as 5000 volts. There would be no difficulty or danger whatever in running a pressure of 1000 volts, if the mains were properly made and laid.

Cross-examined by Mr. SHIRESS WILL, witness stated that in Berlin the installations were about half a mile distant, supplying current to a quarter of a mile on either side. Provided they could obtain suitable places for their machinery, he thought the distance for the stations adopted at Berlin would be very suitable. It was merely a matter of money. He did not attach much importance to all the talk about noise, vibration, and smoke being a nuisance to the public. They had had experience as to this at the Savoy Theatre, where they had 1200 lights; but nothing whatever had been heard about nuisance—in fact, he did not think the public would have known anything of it if they had had 10,000 lights. He thought also that the Grosvenor Gallery was another case in point.

Cross-examined by Mr. GRIFFITHS, witness said he wished to correct a statement as to his experience of pressure. It was 2000 and not 5000 volts, as he previously said. The 10,000 volts of which he had spoken was simply an experiment conducted at Woolwich to see how the machinery would behave, and not to test the main in any way. His firm lighted a part of the City—London Bridge, King William Street, King Street, and the Poultry. This was done by contract for one year; and they were willing to continue the contract to the end of the year at the same price as they undertook it. There were six large arc lamps, and 28 small ones; but it was for street lighting only, and was done under the direct system.

In further cross-examination, witness stated that there was no danger in making connections with the current. It was perfectly safe if the joints were made by those who knew what they were about. What danger there was would arise from short circuits; and the danger was equal whether at low or at high pressure. Whatever difficulty there had been about noise, vibration, or smoke had been overcome; and there were no further complaints. The fitting into the network of mains could be done as well under the alternating system as under the continuous system.

Sir *W. Thomson*, examined by Mr. CRIPPS, said he was acquainted with the system proposed by the Metropolitan Electric Supply Company for the supply of electric light; and he considered it the best that could be adopted for London. The system was one of alternating currents and transformers. It was capable of being used, by means of central stations, in crowded places. The highest pressure in the mains was 2400 volts, as at the Grosvenor Gallery.

Cross-examined by Mr. GRAHAM, witness stated that he had seen the works at Deptford, and knew the system by which the London Electric Supply Corporation proposed to bring their electricity up to London. He did not know of any higher pressure than the 2400 volts at the Grosvenor Gallery. The largest voltage of which there was any practical experience was 1000 volts. To go from 2400 to 10,000 volts would be a great experiment; but there was no difficulty. Although they had not had any practical experience, electricians had sufficient knowledge from experiments, to deal with the higher voltage. There was no insuperable difficulty in the way of insulating the mains which came up from Deptford to the distributing mains. It was, however, a large practical experiment; but he had no doubt that the difficulties could be overcome. Provided the insulation was perfect, there would be no sensible leakage in the conductors. There would be no difficulty in sufficiently insulating the outside main to prevent any ill-effects being felt. It could be done without inconvenience. Provided there was proper care on the part of the workmen employed at the factories and on the line, there would be no danger to life from the high potentials. The best system of reserves in case of breakdown would be to have reserve engines for large works at a central station; but for small places, storeage batteries were very valuable. The direct system was some years in advance of the alternating system. But there were now a large number of lamps in America, and also in London, on the latter system.

Cross-examined by Mr. MOULTON, witness said it was advisable to keep the high pressure as far away from the consumers as possible. In straggling areas, that which was known as the transformer system was preferable. But as to the system best suited for populous places, although he had given the matter great consideration, he had found it very difficult to come to a conclusion which would be applicable for ten or twenty years.

In answer to Mr. SHIRESS WILL, witness said he recognized the propriety of having some reserve producing power. It was no uncommon practice to have two dynamos, one ready to replace the other. He had heard that it was proposed to produce at Deptford electricity with a pressure of 10,000 volts.

Mr. SHIRESS WILL: Is it not a fact that if you have dynamos constructed with a less voltage than even 3000 volts, there is a tendency for the electricity to spark in the necessary space between the armature and the magnet?

Witness: If the dynamo is not well designed, there is such a tendency. But there is no real practical experience to go by, as no dynamo of 10,000 volts has yet been constructed.

Cross-examined by Mr. WALLACE, witness said that at one time he was in favour of the direct system with storeage batteries. In fact, he was so still for some purposes; but for working at a distance it seemed that the transformer system had the greater balance of practical advantages. If they depended on the engine alone, without storeage, they would need to have an engine ready to take up the strain in the event of the dynamo with the full load being put out of gear or breaking down. In case of a breakdown, another dynamo could be switched on very soon; but while this was being done, there would be a failure. He knew that there had been breakdowns.

Mr. WILKIN: Have you ever thought of the possibility of an explosion wrecking the whole of the boilers and dynamos?

Witness: Of course, there is the possibility; but there should be sufficient precautions taken. Practically, the possibility of entirely wrecking a central station, such as that at Deptford, should not be taken into account.

Re-examined by Mr. CRIPPS, witness said that any difficulties arising from bad insulation could be overcome. He did not anticipate any difficulty with the telephonic or telegraphic communications. When President of Section A of the British Association, he had expressed approval of transmitting electrical energy to great distances by the aid of secondary batteries. At that time transformers had not been brought to his notice for such purposes. His views as to the relative merits of storeage batteries and transformers had not undergone a change; but since then an opinion had grown up in favour of transformers, and he shared that opinion.

In reply to Mr. LITTLETON, witness stated that there was no difficulty in switching off the current from one dynamo to another. Before any failure of the machines occurred, there was generally considerable warning; and this would give them time to switch off the current.

Mr. *J. S. Balfour*, M.P., examined by Mr. LITTLETON, said he was a Director of the Metropolitan Electric Supply Company. The capital subscribed was amply sufficient for the Company's present purposes. He contemplated a very large extension of the undertaking in the future. It was, he believed, upon the strength of the statement in the prospectus that there would be a large extension that the shareholders subscribed. Upon the question of the application of capital upon the formation of the Company, he had a strong view. He was extremely anxious that they should apply in the first place only so much of the capital as was sufficient to make a perfectly complete experiment. His expectations as to the demand for light had been very largely exceeded; the total number having been very much in excess of what he anticipated. He was a large owner of property in the South of London, whence many applications had come. He expected great success in South London, and believed they would have a large number of applications from Streatham and Brixton. He did not apprehend there would be any difficulty in getting increased capital.

Mr. MOULTON cross-examined the witness upon various statements in the prospectus issued by the Company, which Mr. Balfour said substantially represented the intentions of the Directors. They were supplying a great amount of electricity in St. Martin's-in-the-Fields. However, at present they had no statutory powers. They had the consent of the Local Authority. They were in negotiations with the Strand District Board of Works, but had not absolutely entered into an agreement.

Mr. *E. S. Claremont*, examined by Mr. CRIPPS, said he was Manager of the Metropolitan Electric Supply Company. He produced a plan showing the stations of the Company and the districts they proposed to supply. The machinery at the various stations would be perfectly noiseless; and there would be no risk of nuisance arising from noise, smoke, or vibration. His estimate of the inclusive cost per mile of laying down the mains was from £1250 to £1350. This estimate included the opening of the streets, the mains, and everything. The Local Authority for the Company's Mid-London area was the Corporation of London, who had not consented to the Order. But inasmuch as they had asked for a tender for lighting the City, he imagined they would be very glad to have the light there. The London County Council had raised some minor objections. Most of those urged by other authorities could be overcome.

Mr. CRIPPS: Have you already received a large number of applications for electric lighting?

Witness: Yes. For Marylebone we have received applications for 19,720 lights; for St. James's, Westminster, 6350; St. George's, Hanover Square, 1370; the City, 13,640; St. Martin's, 2460; and the Strand, 3140 —making a gross total of 44,660 lights. This does not include those that we are now supplying. These number 11,340. Witness added that if powers were given to two Companies, there would be no difficulty in opening the streets. His Company would in that case be willing to give another Company a month's notice when they proposed to open the streets; and they would specify the hour and day, in order to avoid the difficulty of the roads being opened more than once.

Replying to Mr. SHIRESS WILL, witness said he saw no objection to

competition—there was plenty of room for it in London; but he did not hanker after competition. In the interests of the consumer, he should advocate competition; but in the interests of his Company, he should prefer districting. For some reasons it would be bad for the consumer to have districting. If there was only one company in a district, and the supply was a bad one, the consumers would have no choice of getting another supply.

Mr. WALLACE: Do you not think there is sufficient competition among the gas companies, in view of public and private lighting, without introducing another element of competition among the electric lighting companies for the benefit of consumers?

Witness: I do not consider there is now.

Do you think the argument as to competition between gas companies and between the electric lighting companies is on the same footing?—Are you taking the competition between the electric lighting companies alone, or with the gas companies as well?

Would there not be much greater need for the electric lighting companies to arrange, as in the case of the gas companies, for a sliding scale and standard prices?—I do not quite understand your question.

It was pointed out that you might in future arrange with another company without competition for protection, by adopting a standard price?—But there will be a standard price, I take it, because all the electric lighting companies will eventually have to charge the same price. From a consumer's point of view, of course, competition is desirable. If there is only one company in a district, I admit that, as they would get more custom and have more lights to supply than if there were competing companies, they ought to be able to supply the light cheaper.

In answer to Mr. GRIFFITHS, witness said it was proposed to have one main on each side of the street; so that if there were two companies there would be four mains in the street. All the 13,640 applications from the City had been followed up by calls, either by himself or one of the staff; and they had all been booked as permanent applications. The price at which they were to supply them was named. It varied according to the size of the lamp required. They said they would supply the current at 7¼d. per unit. It was part of the agreement that the consumer took the light for three months. They were invited to tender for lighting the City under specifications of agreement by which the City was divided into three areas, and the undertakers might tender for each area separately or for all three; but the terms of the specifications were impossible for them, as they were too binding. In their own Order there was no obligation to lay down any mains for private supply. Their system was to go entirely underground; but, as a matter of fact, some of the streets in the City were so small that they would be forced to go overhead, as there would be no room for their mains underground.

Cross-examined by Mr. W. YOUNG, witness said he hoped the Company were never going to give a defective supply; but supposing through their own fault the supply was defective, it would not be unreasonable to be subjected to some penalty. The Company objected to supply the light upon a sliding scale such as was recognized by the gas companies. He declined to give any reasons for this objection.

Mr. YOUNG: Tenpence per unit is the price allowed to be charged by the Board of Trade.

Witness: Although 10d. is allowed by the Board of Trade, we do not intend to charge that. We do not propose to charge more than 7¼d.

Major MARINDIN: Where do you get the figure of 10d. from?

Mr. YOUNG: That is a mistake of mine. I should have said 8d. It is equal to 6s. 8d. per 1000 cubic feet of gas.

Witness, in further cross-examination, said that a letter had been received from the Wandsworth District Board of Works asking if the Company would be prepared to light a certain number of streets within a given time. A reply was sent giving prices for supplying lights from various parts; but they had not yet received any further application from the Board. The Company had been asked by several large builders whether they would supply their houses; but nothing definite had been settled. He had great objections to giving the local authorities a veto on the site the Company might select for their generating stations. When they had selected a site, they would be quite ready to let the authorities know; and if they could show any good reasons for objecting, then the Company would do what they could to find another and less objectionable place. But the Company could not allow a clause to be put in the Provisional Orders for vetoing their selection of sites for stations.

Mr. CRIPPS: There has already been an inquiry as to the charging for the light on the sliding scale?

Witness replied that there had; and he believed it had not been found applicable to the electric light. Although the Company had expressed its readiness to tender for lighting the City, it was impossible to do so under the specifications. Upon a requisition from six owners, the Company were bound to supply light for private purposes; and upon a requisition from the local authority, they were also bound to furnish public lighting.

And your obligations are analogous to those under the Gas and Water Works Clauses Acts?—Yes.

The inquiry was adjourned until the following Wednesday.

FATAL ACCIDENT AT THE THIRLMERE WORKS.—On Thursday night a man named John Mitchell, about fifty years of age, employed in tunnelling at the Thirlmere Water-Works, near Grasmere, had charge of removing the rock in trucks, drawn by a horse. While so employed, Mitchell being seated upon one of the trucks, a youth endeavoured to "sprag" the wheels to prevent them running too quickly, but was unable to do so. The result was that the speed of the trucks increased in velocity down an incline, fell over an embankment, and upon Mitchell, who was shockingly crushed. He died almost immediately.

LARGE REDUCTION IN THE PRICE OF GAS AT BANGOR.—At the recent monthly meeting of the Bangor City Council, the Water and Gas Committee reported in their minutes that they had decided that the price of gas should be reduced from 5s. to 4s. per 1000 cubic feet, provided the Local Government Board granted the necessary powers; the reduction not to commence until June 25 next. On the presentation of the minutes, Mr. W. Jones moved that the price of gas be reduced to 3s. 6d. per 1000 feet, and not to 4s.; arguing that unless the price was lowered to the figure he proposed, they would not be able to compete with oil. The falling off in the consumption of gas during the last three years showed how strong an opponent they had to deal with. Before Mr. Dew seconded the motion, a letter was read from the Local Government Board stating that, in response to the inquiry held by two of their Inspectors into an application by the Council to have the Water and Gas Act amended so as to bring about a reduction in the price of gas, they agreed to a reduction from 5s. to 3s. 6d. being made, and a Provisional Order to that effect would be issued. The matter was then debated at considerable length; and in the course of the discussion, replying to a question, the Gas Manager (Mr. J. Smith) said that if there was no increase of consumption, the deficiency per annum with a reduction of 1s. would be £800, and with a reduction of 1s. 6d. £1200. Mr. Jones's motion was ultimately carried.

EXTENSIONS AT THE PAISLEY CORPORATION GAS-WORKS.

Within the past few weeks, brief mention has been made once or twice of extensions that had been resolved upon in connection with the Paisley Corporation Gas-Works, and we now proceed to deal with the matter in more detail. The proposed extensions are based upon certain suggestions made in a report prepared some time ago by Mr. Geo. R. Hislop, the Engineer to the Corporation Gas Commissioners, and subsequently considered by them.

In a report by Mr. Hislop (dated Feb. 5, 1888), it was recommended that the present old retort-house should be reconstructed, and that settings of retorts on the regenerative system should be adopted. But instead of doing this, the Gas Trust sanctioned the erection of 64 retorts in the other house; and this work was carried out during last summer and autumn. In that house it was presumed that the erection of 64 additional retorts during the coming summer, in lieu of the present bench of 40 retorts, would suffice for the requirements of the town for next winter. In order, however, to prevent interruption to the public lighting, Mr. Hislop was compelled to repeat his recommendation in reference to the reconstruction of the old retort-house, with 64 retorts placed on one side of the same, in addition to the 64 to complete the other house. This arrangement would, he said, give 192 retorts on the regenerative principle of firing, and leave 36 on the old system. These would be capable of producing the estimated daily quantity of gas for next winter's demand, amounting to 1,584,000 cubic feet, and leave 30 per cent. of the retort power in reserve, and so enable the Gas Trust to pass through next winter even with the present deficient gasholder capacity. Moreover, considerable economy would result from a speedy change from the old to the new system of firing the retorts, as Mr. Hislop had found that in the use of the retorts which had recently been erected, a saving was effected in fuel and wages of about 1s. 2d. per ton of coal carbonized, after allowing for interest on the extra capital, instead of from 6d. to 8d. per ton as previously estimated.

Mr. Hislop went on to say that he had found that the amount required for the 128 retorts he had recommended would be, including royalty, £2472; the new retort-house and chimney (as per his former report), £1552—total, £4024. Of the amount mentioned for retorts, he pointed out that about £492 would be necessary to effect the renewal of the ordinary retorts in the present ovens, so that the extra cost would be reduced by this amount. The cost of the same number of retorts on the Siemens and Klönne systems (after deducting £492 for reduced contract rates, as for those erected on the Hislop system) would be £4382; new retort house, with deeper foundations, £1687—total, £6069. While reconstructing the old retort-house a favourable opportunity would, in the reporter's opinion, be afforded for covering in the open space to the south side, and including the railway siding, 127 feet long by 60 feet wide, which would prove not only profitable financially, but also convenient for coal storeage, which is now very limited, and its extension urgently called for.

In reference to the gasholders, Mr. Hislop said that the last one was erected in 1877, with an available capacity of 640,000 cubic feet. The total cost of the holder and tank was about 13,000. When its construction was arranged for in December, 1876, the consumption of gas during two or three days of that month reached 760,000 cubic feet, while next winter it will probably be fully twice this quantity. The present total available capacity of the gasholders is only 960,000 cubic feet, whereas a maximum daily consumption of 1,553,000 feet was reached last December. Hence it will be seen that the construction of another tank and holder cannot possibly be delayed beyond the summer of 1890; the work being commenced not later than the 1st of February. The size Mr. Hislop recommended was 162 feet in diameter, in two lifts of 32 feet each; the total available capacity being upwards of 1,300,000 cubic feet. As to purification, Mr. Hislop remarked that the last addition to this plant was made in 1878, and that it would now be necessary to provide two extra purifiers simultaneously with the construction of the tank and holder.

After these matters had been considered by the General Commissioners in Committee, they sanctioned the erection of 128 retorts (16 ovens of 8 retorts) on Mr. Hislop's patent regenerative principle, and same as the 64 erected last year, and also that the present retort-house should be reconstructed from the foundation, and enlarged so as to contain the number of retorts mentioned, with new chimney, as also a similar house adjoining for a coal-store; the whole to be proceeded with at once, all in terms of the report. The retort-house will be 106 feet long and 62 feet wide; and the coal-store will be 127 feet long by 62 feet wide. The construction of the tank and holder was also agreed to; and in addition to these two important extensions of the works, two new purifiers are to be constructed next year, each 36 feet by 30 feet. The total cost of the various extensions now authorized is estimated at about £25,000.

THE PUBLIC LIGHTING OF THE CITY OF LONDON.

The annual report of the Engineer and Surveyor to the Commissioners of Sewers of the City of London (Mr. W. Haywood) has just been issued; having been presented on the 2nd inst. It gives, as usual, particulars of the arrangements for the public lighting of the City, from which we make the following extracts:—

The Gaslight and Coke Company sent in a tender for supplying the public lamps with gas for the past year at the price of 2s. 2d. per 1000 cubic feet; the number of lighting hours to be 4300. The following table gives the cost of lighting the lamps:—

Size of Light.		Annual Charge per Lamp.			
Ft. per hour	Description.	Gas.	Lighting.	Repairing	Total.
		£ s. d.	£ s. d.	s. d.	£ s. d.
5	Square	2 6 7	0 15 0	3 0	3 4 7
5	Circular	2 6 7	0 15 0	7 3	3 8 10
10	Square	4 13 2	0 15 0	3 0	5 11 2
10	Circular	4 13 2	0 15 0	7 3	5 15 5

The report contains an interesting table showing the cost per annum of a public lamp within the City of London from 1870 to 1888 inclusive; the burner consuming 5 cubic feet of gas per hour. In 1870 the charge of The Gaslight and Coke Company (who supplied the north district) was £4 15s. 9d. per lamp per annum; that of the Great Central Company, whose contract was for the south district, being £4 12s. 4d. In the following year The Gaslight and Coke Company had the lighting of the entire city; their charge being £4 15s. 9d. per lamp per annum. In 1872 the same figure was charged. In the following year, circular lamps were introduced in addition to the square ones, and for these an additional charge of 4s. 3d. per lamp was made, to cover the extra expense of cleaning. In 1874 the figures were £6 2s. 6d. for the square, and £6 6s. 9d. for the circular lamps. Since that date, however, there has been an annual diminution in the prices charged; and last year they were only about half what they were in 1874. The number of defective gas lights observed

during the past year was 261. These figures were obtained from reports made daily by the police, and comprised only those lamps in which the inferior lighting was very noticeable. In the year 1880 there were 800 defective lights reported; and in the next year, 2509. Since then the number has diminished considerably; only 182 cases being reported in 1884. Mr. Haywood says that the 36 meters attached to the public lamps in various parts of the City, show that the full contract quantity of gas is given at those lamps. The Inspector of Gas Lighting and the Inspectors of Pavements are of opinion that the regulators of the lamps generally are kept in proper condition, and that the full contract quantity of gas is supplied by the Company at all public lamps. Owing to the inconvenience to the traffic caused by fogs, the Company have had, for many years past, instructions to immediately light the public lamps when a fog or darkness occurs in the City. During the past year they were thus lighted during the daytime on 14 occasions. The question of replacing the existing lanterns with improved ones, and with burners consuming much larger quantities of gas, in some of the principal thoroughfares of the City, was again under consideration last year; but no alteration has yet been made.

In March, 1888, an application was made by The Gaslight and Coke Company for permission to supply and fix improved lanterns and burners in certain of the streets of the City, as an experiment and illustration. The Company undertook to pay all costs and expenses of fixing, maintaining, and lighting the lamps for one year. The Commission was asked only to supply new lamp-columns in Cheapside in lieu of the old ones. This application was agreed to. The Company have now fixed larger lamps in the following thoroughfares:—In Cheapside, 23; in the Poultry, 7; in Mansion House Street, 2; in Threadneedle Street, near the Royal Exchange, 10; in Cornhill, near the Royal Exchange, 11; and at the rear of the Royal Exchange, 2—making altogether 55. These 55 large lamps and burners each consume 17 cubic feet of gas per hour up to midnight, and 5 cubic feet per hour afterwards. Their illuminating power, when the 17 cubic feet of gas is burning, is stated to be equal to 75 candles. In King William Street, between Lombard Street and Cannon Street, the Company have fixed 14 lamps; and in Prince's Street (Bank), 3 lamps—making together 17, each consuming 12 cubic feet of gas per hour up to midnight, and 5 cubic feet per hour afterwards. Their illuminating power, when the 12 cubic feet of gas is being burnt, is stated to be equal to 54 candles. In Queen Victoria Street, between Mansion House Street and Cannon Street, the Company have fixed 30 lamps, and at the eastern end of Newgate Street 10 lamps, each consuming 8 cubic feet of gas per hour during the entire time of lighting. These are stated to have an illuminating power of 36 candles. The total number of lamps fixed by the Company is 112. The entire lighting was in operation on the 5th of March of the present year.

Permission was also given to the Defries Safety Lamp and Oil Company to light a portion of the Holborn Viaduct with their pneumatic safety lamps; the Company being permitted to use the existing lamp-columns for the purpose. The portion of the Viaduct lighted is on both sides of the way, westwards of the Farringdon Street Bridge, and the lamps round the Viaduct Circus. The number of these lamps on the Viaduct is 18; and in Holborn Circus and round the Prince Consort Statue, 12—making together 30. These were all fixed by the 25th of February last. The lamps are intended to burn the ordinary petroleum oil; the oil reservoir being above the flame. The illuminating power of each of the lamps on the Viaduct is stated by the patentees to be equal to 20 candles; of those in Holborn Circus, which are larger, 100 candles. The experiment is to last for twelve months. The whole of the work is to be at the entire cost of the Company.

With regard to electric lighting, the report states that during the past year none of the public ways of the City were lighted by electricity. The Commission on the 6th of March decided not to enter into a contract with the Anglo-American Brush Electric Light Corporation, for lighting the area respecting which lengthened negotiations had taken place, and which area represented about one-sixth of the public ways of the City. One reason for the Commission so resolving, was the belief that during the year an alteration would take place in the Electric Lighting Acts, which might enable more satisfactory conditions to be arranged between the Commission and any company supplying the City with electricity. This proved to be the case. The Electric Lighting Acts were amended, and the matter was afterwards referred to Mr. Haywood to report the conditions he would recommend, as a basis for a specification for supplying the City with electricity. After conference with Mr. W. H. Preece and Mr. Baylis (Solicitor to the Commission), the Engineer reported his opinion to the Committee on the 16th of November. His report briefly was to the effect that the conditions of agreement which it had been proposed to enter into with the Brush Company might be adopted generally as a basis for the specification. The Committee, after close consideration, approved of this, and further agreed to recommend to the Commission: (1) That all the streets of the City should be lighted by electricity. (2) That all conductors should be laid beneath the public ways. (3) That, for the purpose of tendering, the City should be divided into three districts; the Commission to retain the power of giving one or two districts, or the whole of the City, to one company, if advisable. (4) That there should be a participation in the profits, between the Commission and the company, when a maximum dividend had been obtained by the company. These recommendations of the Streets Committee were approved by the Commission on the 26th of February of the present year. The specification has been prepared, and advertisements have been issued with the object of carrying the resolution of the Commission into effect. The Commission were asked, during the past year, to consent to applications that various electric light companies and others were about to make to the Board of Trade for Provisional Orders to supply electricity to the City. These applications were referred to the Streets Committee, who at that time were considering the question of the desirability of obtaining tenders for lighting the entire City, and it was resolved to withold their consent.

THE PUBLIC LIGHTING OF NEWCASTLE.

At the Meeting of the Newcastle City Council last Wednesday, Alderman Potter submitted for adoption a report of a special meeting of the Watch Committee held to consider the question of the lighting of the city. He said an intimation had been received from the Gas Company to the effect that, if the Corporation persisted in their determination to keep a number of the lamps extinguished during the summer months, the usual discount of 20 per cent. off the 1s. per lamp per week would not be allowed. He and the Vice-Chairman of the Committee had waited that morning upon the Directors of the Company, with the object of trying to induce them to give them the same terms as they did last year, but they would not accede to the request. A special meeting of the Watch Committee was afterwards held, and the following resolution was adopted:—"That, seeing that the Gas Company refuse to allow the 20 per cent. discount if partial lighting of the city during the summer months be determined on, this Committee requests the Chairman to move at the Council meeting to-day the rescinding of the resolution passed by the Council on the 21st of March, 1888, and that an additional £1200 be added to the estimates of this Committee." He said the saving last year was £1200; but if the discount was reduced from 20 per cent. to 15 per cent., the saving would be reduced to about £550. They believed that the efficient lighting of the city was of more importance than the saving of £550. The partial lighting of the city had not been received by the public with so much favour as they had anticipated. Mr. Goolden seconded the motion. Mr. Carse said that he had heard very few complaints in regard to the lighting. Mr. J. Baxter-Ellis could not understand how the Gas Company was allowed to "play fast and loose" with them. It simply meant this—that, unless they consumed a certain amount of gas, the Company would do as they liked with them. Alderman Hedley said that, up to 1883, a portion of the lamps were regularly turned out during the summer months. The discount then allowed was 10 per cent. The Corporation then resolved to light the lamps all the year round, and asked the Gas Company to allow them a little extra discount; and the Company agreed to allow them 20 per cent., on condition that all the lamps were lighted. There was a probability that coal this year would be dearer than it was last year. While they talked about a saving of £550, they must remember that that meant a loss of £550 to the Company. It was he himself who suggested last year the partial lighting of the city, in order to save £1200. He did that as a member of the Council, and not as a Director of the Company. Mr. Winter said an additional number of lamps had been erected since the arrangement was made; and he thought these would compensate for the lamps they proposed to turn out. They would be consuming as much gas then as when the arrangement was made. It was at length resolved that the matter be remitted to the Watch Committee, with instructions to endeavour to arrange terms with the Company; and that the previous resolution of the Council be in the meantime carried out.

BRUSSELS MUNICIPAL GAS SUPPLY.

The Gas Committee's Report for the Past Year.

The report of the Gas Committee of the Municipality of Brussels, on the working of the gas undertaking during the twelve months ending Dec. 31, 1888, was presented to the Municipal Council at their meeting on the 25th ult. Its chief features of interest, as far as our readers are concerned, will be found in the following abstract translation of the document.

The production of gas in the past year amounted to 24,596,160 cubic metres; being 3,620,000 cubic metres more than in the preceding twelve months. This was disposed of as follows:—

	Cub. Metres.
Night gas, at 15c. per cubic metre	15,299,452
Day gas, at 10c. "	1,883,589
Municipal establishments, at 10c.	694,394
Gas-engines, at 10c.	622,833
Industrial purposes, at 10c.	165,307
Illumination devices, balloons, &c.	835,586
Total sold.	19,001,161
Public lighting and illuminations	3,736,758
Used on the works, &c.	748,241
Unaccounted for	1,110,000
Total production	24,596,160

The following table shows the total quantity of gas made and consumed in the entire period during which the undertaking has been in the hands of the Municipality:—

Year.	Private Consumption.	Public Lighting.	Used on Works, &c.	Unaccounted for.	Percentage of Loss.	Total Production.
	Cub. Met.	Cub. Met.	Cub. Met.	Cub. Met.		Cub. Met.
1875-6	14,445,000	4,316,000	48,000	8,689,000	31·60	27,498,000
1877 .	11,415,647	3,238,774	61,340	3,500,520	19·20	18,216,281
1878 .	12,151,473	2,600,000	103,370	2,000,647	12·03	16,855,490
1879 .	12,692,314	2,411,889	151,332	958,065	7·00	16,153,650
1880 .	13,976,246	2,496,726	274,155	1,335,433	7·39	18,082,560
1881 .	14,772,132	2,547,044	283,731	1,430,013	7·52	19,032,920
1882 .	14,993,155	2,606,187	274,886	1,376,212	7·15	19,249,940
1883 .	15,397,511	2,676,960	320,939	1,310,690	6·69	19,606,100
1884 .	15,718,337	2,714,395	348,662	1,172,596	5·91	19,953,990
1885 .	14,644,043	2,768,130	410,286	906,071	4·84	18,728,530
1886 .	14,660,966	2,734,305	583,605	1,135,514	5·94	19,104,390
1887 .	16,405,392	2,800,553	662,231	1,105,344	5·27	20,975,720
1888 .	19,001,161	3,736,758	748,241	1,110,000	4·51	24,596,160

The consumption of night gas last year exceeded that of the preceding twelve months by 1,845,792 cubic metres, or 13·72 per cent.; the quantity burnt at the exhibition being 290,000 cubic metres. The number of double-index meters in use at the end of the year was 5037, as against 4255 at the corresponding period of 1887. There were 1,883,589 cubic metres of day gas paid for, as against 1,633,913 cubic metres in 1887—an increase of 249,676 cubic metres. The Gas Committee fix meters and exchange ordinary for double-index meters gratuitously. Last year 1351 new meters were put in, and 676 removed; so that the total number in use at the close of the year was increased by 675, making it 12,315. The Committee also fix without charge house services, similar to those fitted up by the Paris Gas Company, for the supply of "flats;" and at the end of last year there were 221 in use, supplying gas to 270 meters. They likewise undertake to supply interior gas-fittings, either on hire, at a charge of 5 per cent. on the cost, or on sale, with payment by annual instalments. There were 224 new installations last year, at an outlay of 17,000 frs. Since July last the Gas Committee have placed gas hot-plates and roasters at the disposal of the tenants of houses belonging to the Municipality—the former free of charge, and the latter at the merely nominal rental of 25 c. per month. This exceptional consideration is confined, for the present, to the occupants of City property; the Gas Committee being desirous that the requirements of private consumers in this respect should be satisfied by private firms. The price of gas for motive power was reduced in 1883 to 10c. per cubic metre. The following table shows the progress made in the use of gas-engines since then:—

Date.	Number of Engines Fixed.	Consumption of Gas Cubic Metres.
Dec. 31, 1883	70	201,121
" 1884	81	236,671
" 1885	88	291,166
" 1886	116	383,968
" 1887	134	495,275
" 1888	154	622,833

The public lighting of the city is mainly by gas, though, as already stated in the Journal, the Municipal authorities are contemplating the introduction of the electric light. At the close of last year there were in use 5157 public lamps, of which 516 are extinguished about midnight.

With regard to manufacturing operations, the report states that in June last the contracts for the supply of coal were renewed at slightly increased rates, ranging from 50c. to 1fr. per ton. The quantities were: 45,000 tons from Belgium, 21,000 tons from England, 6000 tons from Germany, 6000 tons from France, and 2000 tons from Scotland. The increased cost of

the raw material was not compensated for by an advance in the value of the residuals. The total quantity of coke sold during the year was 402,500 hectolitres (1,106,875 bushels). The tar and liquor were disposed of under existing contracts. The manufacture of compressed fuel proceeded steadily during the year; about 4200 tons of blocks having been produced. In view of the increased consumption of gas, enlargements of the works are being carried out, and when these are finished the manufacturing power will be 30 million cubic metres (1060 million cubic feet) per annum. The new gasholder of 37,000 cubic metres capacity, which is now being constructed, is expected to be finished about September next.

With regard to the financial part of the report, the expenditure charged to capital account last year amounted to 165,584 frs., bringing up the total to 13,788,007 frs.; but there were some additional charges defrayed out of revenue. The following are the principal items in the revenue and expenditure accounts:—

Expenditure.

	Francs.		Sterling.
Manufacture—			
Coal and other carbonizing material	1,053,192	..	£42,128
Purifying materials	4,251	..	170
Engine fuel, &c.	24,694	..	988
Salaries, wages, and retort-house charges	247,661	..	9,906
Transport of material	106,439	..	4,258
Maintenance of works and plant	362,065	..	14,483
Contribution to workmen's provident fund	4,588	..	181
Miscellaneous	36,215	..	1,449
Distribution—			
Public lighting	123,392	..	4 936
Main and service laying, maintenance, &c.	193,851	..	7,854
Meters, meter repairs, and testing	57,556	..	2.302
Salaries, wages, and workshop expenses	101,089	..	4,043
Balance of contribution to stove competition in 1886	3,000	..	120
Contribution to Belgian Association of Gas Managers	6,000	..	240
General expenses	3,506	..	140
Office and other expenses	143,031	..	5,721
Total	2,460,470	..	£98,419

Revenue.

	Francs.		Sterling.
Sale of gas	2,657,291	..	£106,292
Do. coke	663,120	..	26,525
Do. tar	100,242	..	4,010
Do. ammoniacal liquor	119,248	..	4,770
Do. spent purifying material, &c.	47,256	..	1,890
Meters, services, and fittings	146,572	..	5,863
Miscellaneous	74,638	..	2,985
Total	3,808,368	..	£152,335
Deduct expenditure	2,460,470	..	98,419
Balance in favour of Municipality	1,347,898	..	£53,916

The budget estimates for the year were 3,500,000 frs. receipts, and 2,000,000 frs. expenses. So that the estimated surplus of 1,500,000 frs. was not reached by 152,102 frs. It should be stated, however, that the capital charges already mentioned as having been defrayed out of revenue amounted to 189,665 frs.; making the real profit on the year's working 1,537,563 frs. (£61,502).

SAN PAULO GAS COMPANY, LIMITED.

The Nineteenth Ordinary General Meeting of this Company was held last Wednesday, at the London Offices, No. 1, Pinner's Hall, Great Winchester Street, E.C.—Mr. F. Delmar, F.S.A., in the chair.

The Secretary (Mr. J. Heath) having read the notice convening the meeting, the minutes of the last meeting were read and confirmed.

The Chairman, in moving the adoption of the report and balance-sheet, referred to the large extensions that had been made, necessitated by the increase in the Company's business, and which had caused a rather deep dip into the reserve of invested cash, and had been so arranged as to avoid borrowing money; the shareholders continuing to receive an unvarying 10 per cent. dividend, which was a most desirable thing. He then continued: There is a paragraph in the report which no doubt has given rise to some astonishment, as the cause of its insertion has already done to the Directors—the Provincial authorities at San Paulo stating, or implying, that the terms of the concession to the Company expired in December of last year, instead of in 1897. Therefore, with so contradictory an interpretation to our own of its meaning, we sought the opinion of most eminent Brazilian Counsel, who have expressed themselves in favour of our claim that the concession does not terminate until 1897. I will read to you these legal opinions. [The Chairman here read the opinions.] In the Government organ of Jan. 1, last our attention was directed to an article referring to the concession, containing a remark inferring "that we did not wish for a new contract." That seems to point out some wavering of opinion, and nothing more, on the part of the Government. Also, it is further implied to be so, as our representative has never been informed of any intention of that nature by the Government authorities. Then again I ask, What possible object can the Government have in a new contract, where there are many consequent objections to encounter from strange and inexperienced management in place of experience of the highest qualification, and the most favourable results alike to consumers of the gas, to the Government itself, and to you as shareholders. The gas we supply is of greater illuminating power than that demanded, and cheaper than the terms contracted for. Meters are provided without cost or rental—a generosity of action without parallel in gas history in favour of consumers. All this is done from the power acquired by economical and practical working of the various details of the manufacture of gas; also in the extensions, by the selection of the most suitable materials; and by the exercise of a most vigilant and unceasing care in all matters. We are prepared for any unexpected emergencies, such as sudden demand for public illuminations, &c. I may point out that had it not been for a rapidly increasing cost of freight augmenting the expenses of the Company, it was contemplated making a further reduction in the price of gas to private consumers. The particulars of the variations in the cost of freight I give you *seriatim* for the last four years:—1886: Lowest, 17s.; highest, 19s.; average cost of shipments, 17s. 9d. 1887: Lowest, 16s. 6d.; highest, 19s.; average, 17s. 9d. 1888: Lowest, 20s. 6d.; highest, 29s. 6d.; average, 23s. 6d. 1889: Lowest: 25s.; highest, 29s.; average, 28s. 5d. In reverting to the terms of the concession, I would remind you that the various public journals that commented upon its meaning, all, without exception, advocated the cause of the Company, in perfect accord with the legal opinions above quoted; and also reverting to the prudence, or imprudence, of making any change in the concession, I refer to the expiration of the contract for lighting another Brazilian city with gas by an English Company. The works were taken over, and the service continued by a new body, with the result that consumers are complaining bitterly of bad gas, and even the shopkeepers have to increase their light by using kerosene lamps, whereas the original English Company had given entire satisfaction to all. I have now brought to your notice all the particulars that duty towards the shareholders commands, so that you can arrive at your own conclusions. Also, in prudence to all parties relatively concerned, I have spoken courteously, suggestively, and, I hope, convincingly, for it is the shareholders' special interest that is in question, and a governmental responsibility, and the duty of Directors is to spare no pains or watchful care over those particulars being fairly followed out, as much by a company towards the concessioners as by the concessioners to the company. And with all these particulars before us, it is hardly possible for a moment to entertain an impression that a great people and a great nation would raise so frivolous a dispute as the report here implies, both undignified and unwise. I should be inclined more reasonably to expect to find a desire on the part of the Government, in their own interests, to increase the length of term of the concession, rather than shorten it, with the example before them of the result of the change they made in the Company before referred to, as they in all probability now see that they cannot expect a management in other hands so much to their satisfaction and their advantage as ours is. I think I have now grasped every question at issue, and rest in the hope of a just and favourable termination of the question.

Mr. W. C. Fowler seconded the motion, and it was carried unanimously.

A dividend of 10 per cent. per annum for the six months ending Dec. 31, 1888, was then declared.

The retiring Director (Mr. H. A. Cowper) was unanimously re-elected, as was also the Auditor (Mr. Wm. Cash).

The proceedings closed with a vote of thanks to the Chairman and Directors.

MR. W. J. CROSSLEY ON GAS-ENGINES.

A lecture was delivered at Manchester last Tuesday evening, under the auspices of the Manchester and Salford Noxious Vapours Association, by Mr. W. J. Crossley on the use of gas-engines. At the outset, he referred to the great extent to which gas-engines during recent years had been brought into use, as many as 33,000 to 35,000 of them being found at work in 1888. Up to 1876 gas-engines might be said to have had a bad name. Since then, however, much had been done; and gas-engines had been made indicating over 100-horse power. Hundreds of steam-engines had been replaced with gas-engines. As compared with steam, gas-engines were only in their infancy; but in the next decade they would no doubt make great progress. Experiments had shown that the gas-engine, as far as heat was concerned, was twice as economical as the steam-engine—*i.e.*, steam-engines under 100-horse power indicated. In the matter also of convenience, cost, space occupied, &c., the advantage was on the side of the gas-engine. But the prime question to the Association was, no doubt, as to how far the construction of gas-engines would affect the smoke nuisance. The true remedy for ills in this respect was gas power. There were now at work in Manchester and Salford about 700 gas-engines—650 "Ottos," and about 50 of other kinds; and but for them there would probably be 500 more chimneys in the district, contributing their quota of smoke to the general murkiness, and tending to make the death-rate still higher. It was a strange thing that in Manchester there was not a single gas-engine in use in any of the gas-works, nor was any rebate made in the price of gas to encourage their use. On the contrary, as the price of gas in Manchester could not be viewed in any other light than as a tax in so far as one-fourth of its value was concerned, gas-engine users were taxed by the Corporation to the tune of one-quarter of their gas bills over and above non-users. It could not be supposed, he said, that with their splendid gas-works gas ought to cost more to make in Manchester than it did in Sunderland, Leeds, Halifax, Plymouth, Sheffield, Leicester, or other large towns where coal ranged at much the same prices. In Manchester the gas profits took the place of taxes. His firm had recently sent out about one thousand letters to gas companies to ascertain what was their practice in relation to the consumption of gas for power and heating. Only 245 replies had been received up to date, or analyzed; but of these 50 companies did not make a special rebate for a large consumption of this kind, while 24 expressed their intention of doing so. He considered that in large towns, where gas profits were applied to the reduction of rates, a special reduction ought in all fairness to be made for power purposes and also for large consumption which was out of proportion to rateable value. A vote of thanks was passed to Mr. Crossley at the close of the lecture.

The Price of Gas at Beccles.—It was resolved at the meeting of the Beccles Town Council on Monday last week that a Committee (which was appointed) should negotiate with the Gas Company for a reduction in the price of gas consumed for public lighting. The present charge is 4s. 5d.; and it was complained that the Council were not treated even so well as large consumers, as no discount was allowed off the full price.

Wigan Corporation Gas Supply.—At a meeting of the Wigan Corporation Gas Committee last Wednesday, the Borough Treasurer produced a balance-sheet showing a net profit on the working of the department for the past year of £6202. It was resolved that the sum of £6000 be handed over to the general district fund; and the balance of profit carried to next year's accounts. It was decided to hold a special meeting to-morrow, to consider the Gas Engineer's (Mr. J. Timmins's) annual report.

The Water Supply of Morley and Garforth.—A deputation from the Morley Town Council, including the Chairman and several members of the Water Committee, waited upon the Water-Works Committee of the Leeds Corporation last Friday week, to ask that the water now supplied to that borough by the Leeds Corporation might be doubled in quantity. In the course of the interview, the Town Clerk of Morley (Mr. Hopkins) pleaded that the extra water required should be furnished at the price charged for the existing supply—6d. per 1000 gallons. On the part of the Corporation of Leeds, it was urged that, as the granting of the application would necessitate the laying of larger mains, the Morley Corporation ought to pay interest on the amount expended. Eventually, the application was referred to the Conservancy Committee of the Leeds Town Council.

Electric Lighting Scheme for Folkestone.—The Folkestone Town Council have decided on entering into a contract with Messrs. Crompton and Co., Limited, to light the western portion of the town with electricity for five years. According to the statistics submitted, it appears that the present cost of lighting that part of the town by gas is £1034 3s., with 4312-candle power, whilst the cost to light the same area by electricity will be £1032, with 51,600-candle power; so that the light, although a trifle cheaper, is far superior to the present system. Messrs. Crompton have guaranteed the efficiency of their arc light under very heavy penalties; for it is stipulated in their agreement that, should any of their lights fail, a sum of £62 each should be forfeited—the actual price charged for each lamp being £24. Although the scheme has passed the Council, and has been practically signed and sealed by them, there still remains a difficulty with the Gas Company. Their agreement with the Corporation does not expire until July, 1890; and unless they are willing to allow the agreement to be cancelled with fair of compensation, Messrs. Crompton's contract will either have to be delayed or will become invalid.

THE LONDON COUNTY COUNCIL AND THE WATER SUPPLY.

Report of the Special Committee.

At the Meeting of the London County Council last Tuesday—Lord Rosebery in the chair—a report by the Special Committee on Water Supply was submitted. After stating that the Committee had appointed Mr. J. Beal as their Chairman, and that they recommended Mr. Hutton and Mr. Johnson for filling the vacancies in the number of the Committee, the report went on to say that the Committee had had under consideration the reference to them by the Council, on the 19th ult. (*ante*, p. 585), of the question of the water supply in the Metropolis; and it appeared to them that the first step necessary to enable them to deal with this matter should be the institution of an inquiry as to the whole question of the water supply of London. As such an inquiry would necessarily involve considerable expense, the Committee called upon the Solicitor of the Council to advise them as to the statutory powers possessed by the Council to expend money for such a purpose; and they were advised that no such power now exists. The Committee had also ascertained that the Bill which has been prepared by the Parliamentary Committee for the purpose of conferring further powers upon the Council with respect to the water supply, provides for the introduction by the Council of Bills into Parliament on the subject, and for enabling the Council to defray the expenses of making and carrying on inquiries and negotiations relating to such supply. Under these circumstances, the Committee passed the following resolution:—"That it be reported to the Council that, as the Committee are advised by the Solicitor that the Council has no power to incur any expense in connection with any inquiry as to the matter referred to them, the Committee are of opinion that such inquiry must not be entered upon until the Council has obtained from Parliament power to incur the expenditure necessary in making such inquiry." The Committee, however, consider it desirable that the Council should be furnished with the information relating to the question of the water supply of London, which is contained in a large number of reports of Commissions and Committees, and in various other parliamentary papers, and they have directed the preparation of a digest of this information, with a view to its being furnished to the members of the Council.

Mr. Æneas Smith, in the absence of Mr. Beal, said he had been requested by the Chairman of the Committee to move, if there was any opposition to the report, that it should stand over until the next meeting of the Council.

The Chairman said, as there appeared to be some opposition, the report would stand over until the unopposed motions were carried.

The discussion of the report was therefore postponed until after the Easter recess.

In the course of the sitting, the Parliamentary Committee reported that, in pursuance of the resolution passed by the Council on the 9th inst., the Committee had had before them the draft of a Bill for enabling the Council to make application to Parliament in relation to the water supply. The Committee submitted the Bill, and recommended its approval, and also that the Council should take the necessary steps for its introduction.

The recommendation was approved.

THE LONDON COMMISSIONERS OF SEWERS AND THEIR ARTESIAN WELL.

At the Meeting of the Commissioners of Sewers of the City of London last Tuesday, Mr. Day brought up a report of the Streets Committee relative to the delay in completing the artesian well at Aldgate, and stating that, under the authority given at the last meeting, they had intimated to the contractors that, unless satisfactory progress was made by the 1st of June, steps would be taken to terminate the contract. Mr. Rose-Innes thought it very unsatisfactory. They gave the Committee power to determine the contract forthwith; and instead of doing this, they had made a new contract. The Chairman ought to give the Court very strong reasons for the report before they adopted it. Mr. Day admitted that the whole thing was very unsatisfactory; but the contractors had a great many difficulties to contend with. After fully considering the matter, the Committee thought they were more likely to bring it to a satisfactory issue if they left the work in the hands of the present contractors, than if they took it out of their hands and placed it elsewhere. They had come upon sand, which was an unfortunate thing, as it presented special difficulties. Mr. Ashby said that no doubt the Committee were trying to act as kindly as they could towards the contractors; but he thought it was due to the citizens that they should terminate the contract at once. They had better take immediate action for doing this. In his opinion, the Court should not leave any further option to the Committee; and he would move that the contract be terminated forthwith. Mr. J. C. Bell remarked that they had been played the fool with long enough; and it was quite time they took some definite action. He seconded Mr. Ashby's motion. Mr. Shaw asked what benefit it would be to the Commission if they insisted on breaking the contract. There was a great deal of uncertainty about the sinking of a well. Perhaps the Engineer would explain how the matter stood—whether there was any likelihood of the work being carried out in a given time, and who was to blame for its not being completed before. The Engineer (Mr. W. Haywood) said he thought the contractors had been a most unreasonable time in carrying out the work. No doubt with sufficient appliances and with a knowledge of the work, it might have been much more advanced. The contractors had got into trouble incidental to the work, and how they would get out of it depended upon the means, appliances, and forethought shown to provide against such contingencies as all experienced well-sinkers knew might come upon them at an hour's notice. Mr. Morton said the contractors were told that they must keep on night and day, and they promised to do so. No doubt they had neglected the work; but it was mainly owing to want of money to carry it on. If the Commission determined the contract, it would cost them a great deal more money; but perhaps be cheaper in the end. After some further remarks, Mr. Ashby's proposition for cancelling the agreement was carried by 27 votes to 17. It was then referred to the Streets Committee to inquire into the circumstances of the contract, with instructions to ask for tenders for the completion of the work.

METROPOLIS WATER SUPPLY.

The returns furnished to the Registrar-General by the London Water Companies show that the average quantity of water supplied daily to the Metropolis during the past month was 155,425,673 gallons, against 156,534,723 gallons in the corresponding month of 1888. The number of houses served last month was 748,727, or 208 gallons per house, and 26·6 gallons per head of the population. In March, 1888, the number of houses supplied was 735,551; and the quantity of water allowed for each person 27·3 gallons. Of the entire bulk of water supplied last month, 77,582,844 gallons were drawn from the Thames, and 77,842,829 gallons from the Lea and other sources.

In his report to the Registrar-General on the quality of the Metropolitan Water Supply last month, Dr. E. Frankland remarks: "Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health, was: Kent, 0·5; Tottenham, 1·4; Colne Valley, 1·5; New River and Grand Junction, 1·8; Lambeth, 2·1; Southwark, 2·6; East London, 3·5; West Middlesex, 3·7; and Chelsea, 4·4. The Thames Water sent out by the Chelsea, West Middlesex, and Southwark Companies was inferior in quality to that delivered in February by the same Companies; whilst that supplied by the Grand Junction and Lambeth Companies was superior. The Grand Junction Company again attained the highest degree of organic purity, and equalled the New River Company in this respect. The Chelsea Company, although operating upon the same raw material as that employed by the Grand Junction Company, delivered water which contained more than twice as much organic impurity. This advantage to the customers of the Grand Junction Company is not due to the greater size of the Company's storeage reservoirs, since these have not one-third the capacity of the Chelsea Company's reservoirs; but, by pumping from the gravel beds alongside the Thames, the Grand Junction Company avoid taking in much water direct from the river when the latter is in a foul condition. All these Thames-derived waters were efficiently filtered. Of the water chiefly derived from the River Lea, that supplied by the New River Company was better, whilst that sent out by the East London Company was considerably worse, than the February supply. Both waters were efficiently filtered before delivery. The deep-well waters of the Kent and Colne Valley Companies and of the Tottenham Local Board of Health were, as usual, of a very high degree of organic purity; and the Colne Valley Company's water, having been softened before delivery, was also of good quality for laundry use. The water supplied by the Tottenham Local Board of Health was slightly turbid."

Messrs. Crookes, Odling, and Tidy, in the course of their report to the Official Water Examiner for the Metropolis (General A. de Courcy Scott) on the quality of the daily samples taken of the water supplied to London during the past month, say: "The water furnished to the Metropolis by the seven Companies taking their supply from the Thames and Lea, has continued to exhibit the wholly satisfactory character commented on in our last month's report. The mean results afforded by the three different methods of examination employed—viz., the daily estimation of the degree of colour-tint of each Company's water, the daily estimation of the amount of oxygen absorbable from permanganate by each Company's water, and the weekly estimation of the proportion of organic carbon present in each Company's water (the three methods of examination acting as checks upon one another) are, in the case of all three methods respectively, as nearly as possible identical with the mean results afforded by the examination of the previous month's supply. During the first three months of the year, we have examined a total of 537 samples of the water supplied to the Metropolis by the above-mentioned Companies. Seven of these samples were recorded as exhibiting, under careful examination, a 'very slight' degree of turbidity or deficiency in absolute clearness. The maximum proportion of organic carbon present in any single sample of water examined, early in January, was 0·197 part (the mean proportion in the Thames-derived supply for the three months being 0·164 part) in 100,000 parts of the water. Since January, the maximum proportion of organic carbon present has not exceeded 0·175 part in 100,000 parts of the water. It is to be noted, moreover, that the above are the results afforded by examinations of the water supply conducted during an eminently unfavourable season of the year."

CROYDON CORPORATION WATER SUPPLY.

Cost and Assessment of the New Works—Proposed Softening of the Water—The Working of the Past Year.

At the Meeting of the Croydon Town Council yesterday week, the matters mentioned above were dealt with in the minutes of the Water Committee. In regard to the cost of the new works at Addington (which were described in the Journal for Aug. 7 last), it appeared that the actual expenditure was £54,700, made up as follows:—Land, £500; well, £10,256; buildings and cottages, £6385; engine, £4650; roads, &c., £777; water-mains, £15,281; reservoir, £15,115; contingencies, £1205; water level and telegraphic apparatus, £528. The parliamentary estimate was £46,000. The Committee recommended that application should be made to the Local Government Board for either an increase of the amount authorized by the Act of 1884 from £46,000 to £54,700, or for sanction to a loan for £8700, as the Local Government Board may think most desirable. Respecting the assessment of the works, the Committee had received a letter stating that the new works at Addington had been assessed at £2360 gross, or £1712 rateable value. The Committee, after considering the subject, and having a report from the Town Clerk thereon, recommended that the assessment be appealed against, with power, however, to the Town Clerk to assent to such modification of the assessment as he might consider reasonable. The Committee reported that they had considered a reference from the Council as to whether it was desirable that any steps, and if so what steps, should be taken to soften the water. The Borough Engineer, they said, estimated that the cost would be between a halfpenny and two-thirds of a penny per 1000 gallons; or (say) for the 2,200,000 gallons supplied per day, £2000 per annum. The Committee, after full consideration, stated that, in their opinion, it was not desirable that any steps should at present be taken in the matter. The report was adopted. At a subsequent stage of the proceedings, the Borough Accountant submitted a statement showing that the result of the working of the water undertaking for the year ending Lady-day was a profit of £2701, of which £1951 has been transferred to the general district rate.

THE LEAKAGE AT THE ECCUP RESERVOIR OF THE LEEDS CORPORATION.

At the Meeting of the Leeds Corporation Water Committee last Friday week, the Board Engineer (Mr. T. Hewson, M. Inst. C.E.) submitted a report on the leakage of water from the principal storeage reservoir at Eccup; but it was decided that the document should not be made public. It appears that for some months past the water that has been escaping through the faulty embankment has been becoming more and more discoloured. This fact suggests the inference that, in forcing its way through the bank, the water is carrying with it portions of the earth of which the buttress is formed, and of the cement that has been run into holes bored by machinery in the hope of preventing further mischief. This dirtying of the outflowing water, too, is rendered all the more significant by the fact that, lest it might become worse, the reservoir is not allowed to fill to a point higher than the outlet through which the daily supply flows down to Leeds. This being so, till the leakage is cured, Eccup is not, and cannot be the storeage centre that it was intended to be, for no more water can be sent thereto from the collecting reservoirs in the Washburn Valley than Leeds and the populations which draw their water therefrom consume. The Borough Engineer, it is understood, has lost faith in the possible efficacy of boring holes and pouring cement into them, as the waste of water has not been lessened during the last twelve

months. Boring operations were discontinued in March last year. At that time 79 holes had been sunk, at a cost of something like £5000. The total length of the defective puddle trench is 370 yards. It is said that when the reservoir was constructed, the puddling was never properly completed. For a space of about 80 yards the puddling process was not carried down to the entire depth of the reservoir, despite a protest from Mr. Filliter, who was then the Corporation Water Engineer; and it is stated that there is clear evidence that the escaping water gets through the bank at this particular point. The boring and applications of cement extended over only 23 of the 80 yards of unpuddled embankment; and the outcome of this experiment is doubtful, as it is not known whether the weak part of the basin is where the holes were bored or in some other portion. It is believed that what Mr. Hewson now proposes is that the reservoir shall be completely emptied, or nearly so, for a while, and that, coffer dams having been erected, the embankment shall be thoroughly examined; and, if necessary, completely puddled or otherwise rendered safe. That this undertaking would be somewhat tedious appears to be admitted; and, according to the Borough Engineer's estimate, it would cost at least £15,000. The Committee, however, is convinced that something must be done, and that soon, if the Eccup reservoirs are to be of any service. If the scheme submitted by Mr. Hewson be put into execution, sufficient water for the daily needs of Leeds will, after running by gravitation, as usual, from Eccup, be carried over the empty and faulty reservoir in specially constructed pipes, and sent on to Weetwood. The Committee resolved to take a fortnight to think over the Borough Engineer's report, and then specially meet to consider what course of action is advisable.

NOTES FROM SCOTLAND.

(FROM OUR EDINBURGH CORRESPONDENT.)

EDINBURGH, *Saturday*.

This week has been barren in questions relating to gas and water affairs in Scotland. Attention has been directed partly to the half-yearly Licensing Courts, and partly to the Local Government Bills for Scotland, which have been submitted to the House of Commons by the Lord Advocate. One of these Bills—that relating to the conduct of Private Bill business—if it becomes law, will very considerably affect the career of all measures of a private nature arising on this side of the Border, including, of course, those relating to gas and water. The provisions of the Bill, broadly stated, are that a Commission of three persons is to be appointed in Scotland, who will perform all the functions which at present belong to Select Parliamentary Committees, unless in the case of Bills of an exceptionally important nature, which will be dealt with according to the present arrangements. The report of this Commission is to be taken as the report of a Select Committee; and the same report is to serve for both Houses. Inquiries by the Commissioners are to be conducted in the districts affected. The effect of the latter provision is expected to be economy. Whether this is realized or not, experience only can tell. The problem will present itself in this way: Which is the cheaper method—to take counsel, agents, and skilled witnesses from Edinburgh and London to the district where the bulk of the witnesses reside, or to convey a host of witnesses from the district to London, where the professional gentlemen live? For instance, supposing an inquiry were about to be held in Aberdeen, and a stiff fight were anticipated, I am much afraid that the conveying of three or four skilled witnesses on each side, from London to the "Granite City," and keeping them there for a week, would be a costly proceeding. The derangement of their business would entitle them to charge heavy fees. Supposing the inquiry were held in Edinburgh, the costs would only be abated by the difference of the railway fares between Aberdeen and Edinburgh. In small cases, or those where the evidence of experts is not required, there would, without doubt, be a saving by having the inquiry in the district. But in gas and water inquiries skilled witnesses always figure prominently; so that economy in cases in which the JOURNAL readers are interested, is doubtful. If realized, however, it is likely to be the greatest benefit conferred by the measure. I am afraid facility need hardly be looked for, because, with only one Commission in existence, measures will be apt to jostle each other, and the last on the roll may be a good deal delayed. It has also to be borne in mind that, overshadowed by local opinion, there may be a tendency to present questions to the Commission in a "parochial" spirit, which Parliament would not tolerate; and a second inquiry might be ordered, which would increase rather than diminish costs. Further, in connection with the matter of economy, unless the Commissioners kept a firm hand on the bar, inquiries might be apt to spin out unnecessarily. These are probable rocks ahead. What advantages may be derived from the Bill will, I fear, be more of a sentimental than a practical nature.

The Edinburgh and Leith Gas Commissioners are to hold their first annual dinner next week, when the public may possibly be enlightened as to some of the movements of the Commission.

On Thursday, when some workmen were attempting to take down a portion of the ironwork of the old retort-house in the Edinburgh Gas-Works, which has been removed in connection with the scheme of improvements at present in progress, the whole of the roof and pillars fell. There were a number of workmen about, but fortunately none of them were injured.

After a good deal of delay, the Perth Water Commissioners have approved of specifications for the work connected with the extension of the water supply, which was sanctioned by Parliament last year. The Gas Commissioners, who obtained power at the same time, have nearly completed the improvement of their works. The Water Commissioners, however, have not been able to agree upon a number of points, and, in fact, have had some very disagreeable personal discussions—notably one on Monday, at which the Lord Provost threatened to leave the chair. There was a minority in the Commission who objected to the proposals of Mr. Peattie, the Engineer; and it was chiefly owing to them that matters were made "hot" at the meetings of the Commission. Part of the new scheme consists in laying a new main along the side of the River Tay, in the bed of the river; and there was a contention as to the thickness of the pipe as well as to the description of joint to be used. Mr. Peattie recommended that the pipe should be of cast iron, 1 inch thick, and that the joints should be turned and bored, instead of flange and socket. What the motive with reference to the joints was I cannot say; but the thickness of the pipes was sought to be reduced in the expectation that it would save £200. The Commission, after a long and heated discussion, adopted Mr. Peattie's specifications by 15 votes to 6. Mr. Peattie was objected to as Referee—the minority asking that a neutral man should be appointed; but the Commissioners, by the above division, approved of the report of the Committee on specifications, and also of Mr. Peattie's discharging the duties of Referee. The Commissioners will now advertise for estimates. Meanwhile—usual fate of unthinking opposition—the price of iron has risen by 5s. per ton, and the scheme will cost more than it would have done six months ago, had the economists at the Board allowed it to go on.

The Cupar Police Commissioners last year went in for a scheme of conversion, by which they reduced the interest upon £13,345 of water bonds from 3¾ and 3½ to 3 per cent. This year bonds to the amount of £5270 fall due, and it has been arranged that they shall be similarly converted. These two transactions represent a saving of £96 a year to the burgh.

In the newly-created burgh of Buckie, in Banffshire, a portion of the public-lighting plant seems to have been in such a defective state that the lessees of the gas-works made a claim upon the Police Commissioners for the gas which was lost to them by leakage. After negotiation, however, the lessees (Messrs. Adam) have agreed to put the lamps in order for £10, and to withdraw their claim—an honourable settlement so far as the lessees are concerned, seeing that it is estimated that the cost of the repairs may amount to £30.

(FROM OUR GLASGOW CORRESPONDENT.)

GLASGOW, *Saturday*.

The sixth annual "informal" meeting of gas managers, chiefly those of the western counties, will be held in this city next Thursday. It was intended that Mr. Mackenzie, of Dunfermline, should occupy the chair; but unfortunately he will not be able to attend, and in his stead Mr. John M'Crae, of Dundee, will preside and deliver an address. It was expected that the extensive ammonia-recovery plant at the Govan Iron-Works, erected by Messrs. R. and J. Dempster, of Newton Heath, would have been open to the inspection of the gentlemen attending the meeting; but that is not to be. The proprietors of the works are unwilling to allow any "outsiders" to visit this portion of the works till the plant has been in operation for some time, and has been thoroughly tested.

The amount of gas made last month at the three works belonging to the Glasgow Corporation Gas Commissioners was 257,023,000 cubic feet, which did not differ very much from the quantity consumed. In the corresponding month of last year, the make was 243,029,000 feet; so that there was an increase in the past month of 13,994,000 feet, or rather more than 5¾ per cent.

At the last meeting of the Wishaw Burgh Commissioners, the Corporation Gas Committee submitted in their minutes a recommendation that all gas consumers should be called upon to make a deposit of 1s. per £1 of rental, otherwise their supply of gas should be withdrawn. This portion of the minutes gave rise to a considerable amount of discussion, which was initiated by Bailie Russell, who moved that it be not approved of. He thought it would be bad policy to insist on such a deposit being made; indeed, they might just as well shut up the gas-works. Instead of paying the deposit and continuing to take the gas, a great number of gas consumers would, he was certain, go in for the use of oil. Bailie Murdoch seconded the proposal; and then Provost Thomson, who is Convener of the Gas Committee, explained how the matter at present stood. As a rule, they had an overdraft from the bank of £300, which entailed a loss of £15 per annum for interest. They had also at present a considerable loss from bad debts; and those losses would be done away with. The object of the Gas Committee was to reduce the cost of the gas to all consumers; and bad debts being done away with, or very much reduced, and bank interest swept away, was, he thought, a good step in that direction. He was of opinion, however, that it was only fair and reasonable that those consumers who had lodged their deposits should, on payment of their accounts promptly, have 5 per cent. discount. Further on in the course of the discussion, Mr. John Hamilton, as a member of the Gas Commission, said he was sorry he could not support the proposal of the Gas Committee. He thought the resolution would tend very much to reduce the consumption of gas, and would therefore fail to meet the end in view. He would ask what they were going to do with the £1200 which was to be obtained as deposits. If they gave 5 per cent. to the depositors, and drew 2 per cent. from the bank, this would make a clear loss of £36, or more than double what they were losing at present. He felt certain that the people would look upon the proposal as an insult, and would cease burning gas; and he was also of opinion that those who did not pay shortly after an account was rendered, should at once have their gas supply cut off. Mr. W. Chrystal said he was astonished at the Provost proposing that the gas consumers should advance £1200 so as to save £15 of interest. The late Gas Company lost nothing. He thought, like them, they should at once cut off the supply in the case of accounts not paid. He thought it a piece of preposterous nonsense in people to lodge £1200, and to continue consuming gas at 4s. 2d. per 1000 feet. The Provost in reply said there was a little fallacy in the matter. The rental of gas consumers did not amount to £24,000. He might also say that the money would not lie in bank, as he thought he saw a scheme whereby 7½ per cent. could be taken out of it. On the vote being taken six members were in favour of the Gas Committee's proposal, and four against it.

The Falkirk Joint-Stock Gas Company have secured, at great expense, a piece of ground adjoining their Grahamston works for the purpose of erecting a new gasholder to meet the large increase in the consumption of gas in their district.

On Tuesday of this week a number of Airdrie Gaslight Company's shares (£10) were sold by public auction, and realized £22 5s. each, *ex* dividend. Some ordinary £5 shares in the Airdrie and Coatbridge Water Company were also disposed of at the same sale. They fetched £13 17s. 6d. each. Some 6 per cent. preference £10 shares were sold at £18 12s. 6d. each, and for 5 per cent. £10 preference shares (£4 paid), £7 2s. 6d. per share was obtained.

Sulphate of ammonia was a shade firmer in price in the early part of the week; £12 per ton having been fixed for a small lot, while for forward delivery £11 17s. 6d. was asked.

There has been a steady market for Scotch pig iron this week, but with comparatively little business, owing to the Easter holidays.

A large amount of business is still doing in the local coal trade; and prices have been showing a further firming tendency. For good main coal, 7s. 3d. per ton at harbour terminus has been paid; and sellers have asked 3d. per ton more. A portion of the Lanarkshire colliers are likely to give some bother to the coalmasters over the wages question; a reduction of 2½ per cent. on the rate of wages having been announced, in accordance with the terms of the sliding-scale system of fixing the wages.

ODESSA WATER-WORKS COMPANY, LIMITED.—The report of the Directors of this Company for the year ended Dec. 31 last states that the water-rents for 1888 amounted to £47,620, against £47,935 for 1887, and the miscellaneous receipts to £3548, against £3225. The improvement in the value of the rouble for a portion of 1888 shows that the loss by exchange is reduced from £2988 to £853; and the net revenue, after meeting interest on debentures and all charges, amounts to £11,945. The Resident Engineer reports that during the year the quantity of water pumped from the River Dniester shows an increase of 87,353,285 gallons over that of 1887; that 168 new services were connected during the year; and that the total number of meters in use was 4984. He states that the filters, machinery, mains, &c., are all in good working order, except the boilers, which require renewal; and that the new roof for the engine-house at the Dniester station has been completed. The Directors recommend a dividend of £1 per share, tax free, in respect of the "A" shares.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 20.

Sulphate of Ammonia.—The market displays remarkable firmness, which is specially noticeable in this district, where sulphate is actually scarce. Shipments continue on a satisfactory scale all round, which gives hope that manufacturers will not have to submit to the low summer prices prevailing last year. The prospects of sugar have provoked inquiries for future delivery; and it is probable that to-day's values will be accorded to those makers who are wishful to anticipate the sale of their production. At Hull £11 18s. 9d., and at Liverpool and Leith £11 17s. 6d., has been paid this week. Nitrate is unchanged in value, but hardly so steady.

LONDON, *April* 20.

Tar Products.—There has been but little business done in these during the past week, on account of the approaching holidays; but the prices of the various articles remain about the same, and may be taken as follows:—Tar, 20s. to 25s. per ton. Benzol, 90 per cent., 3s. per gallon; 50 per cent., 2s. 2½d. per gallon. Toluol, 1s. 5d. per gallon. Solvent naphtha, 1s. 3d. per gallon. Crude naphtha (30 per cent.), 1s. per gallon. Light oil, 3½d. per gallon. Creosote, 2½d. per gallon. Pitch, 20s. to 25s. per ton, according to position. Carbolic acid (crude), 3s. 9d. per gallon. Cresylic acid, 10d. per gallon. Tar salts, 17s. per ton. Anthracene (30 per cent.), "A" quality, 1s. 4d. per unit; "B," 1s. 1d. to 1s. 2d. per unit, according to quality.

Ammonia Products are somewhat better; and no doubt after Easter the value of these will be still further enhanced. Prices: Gas liquor (5° Twaddel), 8s. per ton, with a rise or fall of 1s. 6d. per degree. Sulphate of ammonia, £11 17s. 6d. to £12 per ton. Liquor ammonia, 2d. per lb. Carbonate of ammonia, from 3d. to 3½d. per lb. Muriate of ammonia, brown, £19 per ton; white, £23 15s. per ton. Sal-ammoniac, £30 to £32 per ton.

GAS EXHIBITION AT WORKINGTON.—An exhibition of gas cooking and heating stoves and gas lighting on the most modern and improved principles, with a selection of appliances for use in the consumption of gas, is to be held in the public hall, Workington, from Tuesday, April 30, to Saturday, May 4. In connection with the exhibition, a course of practical lectures on cookery will be given each day (Saturday excepted) by Mrs. J. B. Thwaites, of Liverpool. The exhibition will be opened on the first-named day by his Worship the Mayor (Mr. H. F. Curwen).

THE BLACKTON RESERVOIR OF THE STOCKTON AND MIDDLESBROUGH WATER BOARD.—At the meeting of the Stockton and Middlesbrough Water Board on Monday, the 8th inst., Alderman Bulmer moved the following resolution, of which he had given notice:—"That all minutes of the Board ordering the construction of the Blackton reservoir be rescinded, and that the Blackton reservoir be not proceeded with." He contended that it was unnecessary to proceed with this work for 15 years to come, when they considered that, with the exception of 1883 and 1884, the supply of water had never exceeded the 60 million gallons which they had power to pump, and they had other six millions besides that. As soon as the Hury reservoir was finished, they would have an additional 21 million gallons; so that they had practically half as much water again as they had hitherto made use of at their command without exceeding their Parliamentary powers. Alderman Weighell seconded the resolution. Mr. Bainbridge believed it would be a mistake on financial grounds to proceed with the work. The Board's income, he said, was less last year than it was in 1883; whilst their capital expenditure had augmented by £300,000, and their expenses for rates and taxes had increased by more than £1000 a year. He believed the supply of water was sufficient. Some further discussion ensued; and on the motion being put, it was negatived.

OPENING OF NEW WATER-WORKS AT SIDMOUTH.—In the presence of a large representative assemblage, the new works of the Sidmouth (East Devon) Water Company at Peak have lately been opened by Mrs. Kennet-Were, wife of one of the Directors of the Company. Mr. E. Woods, the Engineer, described the works, which are of the most modern type. They were originally established at Sidmouth in the year 1844 by a body of gentlemen who subscribed a small amount of capital and constructed a tank at Cotmaton, and laid mains through a small part of the town, which they considered chiefly required it. These works continued to be the only public supply for more than 30 years, when the Trustees of the Manor were advised that Sidmouth could not flourish as a health resort until a complete service of good water was established. Accordingly, in 1880 they built works at Peak and laid mains. These works were the first water-works erected in Sidmouth having filter-beds. Subsequently the Trustees also acquired the water-works constructed by a resident for the supply of his house and gardens at Knowle. These were enlarged, and connected with the town of Sidmouth. The customers increased, and soon the works became unequal to the demand. At last, in 1886, the Sidmouth Water Bill, authorizing, among other things, the construction of new works at Peak, was passed. These are built from designs of Mr. E. Wood, of Westminster, and have been constructed, under his supervision, with local assistance. They consist of a large tank and two filter-beds and subsidiary works. The capacity of the tank is upwards of 500,000 gallons, and there is ample filtering power. Sidmouth has now, it is considered, a first-class water supply.

PROPOSED NEW WATER SCHEME FOR DARWEN.—The Town Clerk of Darwen (Mr. C. Costeker) has prepared a report stating that the four following schemes have been considered by a Special Sub-Committee:—(1) The purchase of Jack's Hey reservoir and drainage area; (2) the purchase of that part of the Blackburn Water-Works and drainage area known as the Daisy Green and Pickup Bank reservoirs; (3) the purchase of that part of the Liverpool Water-Works and drainage area known as the Upper Roddlesworth reservoir; and (4) the raising of water by pumping. There is considerable objection to the first scheme, which arises from the probability that there would be a strong parliamentary opposition, which might result in an unusually large amount of compensation water being allowed; thus rendering the scheme of little avail in supplying the town's demands. The second scheme is considered not so profitable as the third, though fairly good. The drainage area referred to in the third scheme is 1335 acres; and the Upper Roddlesworth reservoir has a storeage capacity of 180 million gallons. The total yield of water is estimated at 2,680,000 gallons daily, out of which compensation to the extent of 1,000,000 gallons daily would have to be allowed. The price is £120,000. The Sub-Committee have several times examined the Roddlesworth watershed, and are unanimously of opinion that it is the most suitable for Darwen. At a special meeting of the Darwen Town Council last Wednesday, a resolution was submitted to authorize negotiations for the purchase of the Roddlesworth works. An amendment was, however, moved that this scheme be not entertained, as the cost was too great. On the matter being put to the vote, the amendment was carried by an overwhelming majority; and the motion was withdrawn. It was then decided to adjourn the discussion for three weeks.

PROPOSED GAS STOKERS' UNION.—A meeting of gas stokers and firemen was held last Sunday week at Battersea Park Gates, S.W., with the object of forming a union. A large contingent went to the meeting in brakes from Canning Town. The meeting, it is reported, was very successful—about 160 men joining. Mr. Shorne, a gas stoker, maintained that it was unfair to expect men to do such heavy work as theirs; and the object of the union was a reduction of the hours of labour, which was necessary for health's sake, the providing of better sanitary arrangements, and for the relief of those who met with accidents.

THE AUXILIARY WATER SUPPLY TO LIVERPOOL.—At the last meeting of the St. Helens Corporation Water Committee, the Water Engineer (Mr. D. M. F. Gaskin) announced that the profit in connection with the supply of water to Liverpool from May to December last from the Knowsley and Kirby Water-Works of the Corporation was £5250. The Chairman (Alderman M'Bryde) thought the Committee ought to be satisfied with the result of this business. They could bear testimony to the very able manner with which the Engineer had carried out the work; and he and the Deputy Town-Clerk (Mr. W. J. Jeeves) deserved the thanks of the Committee for what they had done. A formal vote of thanks was accorded.

SEWAGE PURIFICATION.—Supplementing the successful trial of Messrs. Jagger, Son, and Tinley's system for the purification of sewage and the utilization of ashpit refuse, as demonstrated at Horsforth in December and January last, we learn that the Works Committee of the Halifax Corporation, impressed with the extreme simplicity, efficiency, and economy of the process, have laid down a filter-bed 100 yards in area; a carbonizing oven is being built; and a trial is to be conducted on a thorough, practical working scale. The outfall is at Salterhebble. The main features of the process are the production, from the ashpit refuse of a town, of a carbon filtering medium, which forms the top layer of an ordinary filter-bed, through which the sewage is passed; giving a clear and inodorous effluent from polluted waters. When the filter becomes choked, the flow is stopped, the bed drained, and the solids deposited by the sewage are raked off to be used for manurial purposes. The sludge is not increased by the addition of anything to the sewage. It is estimated that the land required will be about one acre for each 30,000 inhabitants; and the annual cost for collection and disposal of ashpit refuse and purification of sewage will be about 8d. per head, or say 3d. in the pound upon the rateable value per annum.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(FOR STOCK MARKET INTELLIGENCE, see *ante*, p. 757.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d
590,000	10	11 Apr.	10½	Alliance & Dublin 10 p. c.	10	18½–19½*	..	5 7 8
100,000	10	,,	7½	Do. 7 p. c.	10	13–14*	..	5 7 2
800,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	100	110–112	..	4 9 3
100,000	20	29 Nov.	10	Bahia, Limited	20	24–26	..	7 13 10
200,000	5	14 Nov.	7½	Bombay, Limited	5	6¾–7¼	..	5 3 5
40,000	5	,,	7½	Do. New	4	5¼–5¾	..	5 4 2
880,000	Stck.	14 Feb.	11½	Brentford Consolidated	100	229–234	+2	5 0 5
125,000	,,	,,	8½	Do. New	100	167–172	+2	5 1 9
220,000	20	14 Mar.	10½	Brighton & Hove, Original	20	42–44	..	4 15 5
880,000	20	28 Mar.	11½	British	20	45–47	..	4 15 9
50,000	10	14 Mar.	11	Bromley, Ordinary 10 p. c.	10	20–22	..	5 0 0
89,000	10	,,	8	Do. 7 p. c.	10	13½–14½	..	5 10 4
528,750	10	14 Nov.	8	Buenos Ayres (New) Limited	10	14–15	..	5 6 8
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	107–110	..	5 9 1
150,000	20	28 Feb.	8	Cagliari, Limited	20	25–27	..	5 18 6
550,000	Stck.	11 Apr.	13½	Commercial, Old Stock	100	269–274*	..	5 0 4
130,000	,,	,,	10½	Do. New do.	100	214–219*	..	4 18 2
130,000	,,	28 Dec.	4½	Do. 4½ p. c. Deb. do.	100	128–128	..	3 10 8
557,320	20	13 Dec.	13	Continental Union, Limited	20	47–49	..	5 6 2
242,680	20	,,	13	Do. New '69 & '72	14	32½–33½	..	5 8 5
200,000	20	,,	10	Do. 7 p. c. Pref.	20	38–40	..	5 0 0
75,000	Stck.	28 Mar.	10	Crystal Palace District	100	204–208	..	4 16 2
234,060	10	30 Jan.	13	European, Limited	10	25½–26½	..	4 18 1
120,000	10	,,	13	Do. New.	7½	17½–18½	..	5 5 3
364,060	10	,,	13	Do. do.	5	12½–13½	..	4 16 3
5,468,600	Stck.	14 Feb.	13	Gaslight & Coke, A, Ordinary	100	261–265	..	4 17 9
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	100–105	..	3 16 8
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	260–265	..	3 15 6
80,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	123–128	..	3 18 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	180–185	..	4 1 1
1,800,000	,,	,,	7	Do. H, 7 p. c. max.	100	170–175	..	4 0 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	258–263	..	3 16 1
1,061,150	,,	13 Dec.	4	Do. 4 p. c. Deb. Stk.	100	120–128	..	3 5 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	125–130	..	3 9 8
650,000	,,	,,	6	Do. 6 p. c. do.	100	174–179	..	3 7 0
3,600,000	Stck.	14 Nov.	10	Imperial Continental	100	214–218	..	4 11 9
75,000	5	13 Dec.	6	Malta & Mediterranean, Ltd	5	6–6½	..	5 9 1
560,000	100	1 Apr.	5	Met. of Melbourne, 5 p.c. Deb.	100	113–115	..	4 6 11
541,920	20	29 Nov.	6	Monte Video, Limited	20	18½–19½	..	6 3 1
150,000	5	29 Nov.	10	Oriental, Limited	5	9½–9¾	..	5 2 7
60,000	5	28 Mar.	7	Ottoman, Limited	5	6¼–6¾	..	5 3 8
166,870	10	16 Jan.	4	Pará, Limited	10	5½–6	..	6 13 4
				People's Gas of Chicago—				
420,000	100	2 Nov.	6	1st Mtg. Bds.	100	104–107	..	5 12 1
500,000	100	1 Dec.	6	2nd Do.	100	95–100	..	6 0 0
100,000	10	12 Oct.	10	San Paulo, Limited	10	16½–17½	..	5 14 4
500,000	Stck.	28 Feb.	16½	South Metropolitan, A Stock	100	315–320	..	5 1 7
1,250,000	,,	,,	12½	Do. B do.	100	243–248	..	4 17 9
141,500	,,	,,	13½	Do. C do.	100	255–265	..	5 0 0
600,000	,,	28 Dec.	5	Do. 5 p. c. Deb. Stk.	100	137–140	..	3 11 5
60,000	5	28 Feb.	11½	Tottenham & Edm'nton, Orig.	5	11–13	..	4 8 5
				WATER COMPANIES.				
717,467	Stck.	28 Dec.	9	Chelsea, Ordinary	100	257–262	..	3 8 8
1,720,560	Stck.	11 Apr.	7½	East London, Ordinary	100	205–209*	..	3 11 9
700,000	50	13 Dec.	9	Grand Junction	50	122–126	..	3 11 5
708,000	Stck.	14 Feb.	10½	Kent	100	272–277	..	3 15 9
1,043,800	100	28 Dec.	9	Lambeth, 10 p. c. max.	100	251–255	..	3 10 8
406,200	100	,,	7½	Do. 7½ p. c. max.	100	199–204	..	3 13 6
200,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	118–120	..	3 6 8
500,000	100	14 Feb.	12½	New River, New Shares	100	350–353	..	3 8 4
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	100	125–128	..	3 2 6
902,300	Stck.	13 Dec.	6	S'thwk & V'xhall, 10 p.c. max.	100	173–178	+1	3 7 5
126,500	100	,,	6	Do. 7½ p. c. do.	100	161–166	..	3 12 3
1,155,066	Stck.	,,	10	West Middlesex	100	264–269	..	3 14 4

*Ex div

PROPOSED WATER-WORKS FOR RUSHDEN.—A parish meeting was held a short time since at Rushden, to consider the question of establishing water-works for the supply of the inhabitants. A resolution was proposed approving of the construction of works, providing the cost did not exceed £6600; but it was negatived, and the following amendment was passed:—"That this Vestry approves of the establishment of water-works provided they can be secured at a reasonable cost."

MONTE VIDEO WATER-WORKS COMPANY, LIMITED.—The report of the Directors of this Company for the past rear states that the gross revenue amounted to £74,335—an increase of £3245—and the net income amounted to £50,537, against £50,423 in 1887. The Directors recommend a dividend at the rate of 5 per cent., tax free; placing £12,000 to the special reserve fund, raising it to £44,000; and carrying forward £1259. The Directors have, it is stated, made an arrangement with the River Plate Trust Loan and Agency Company, Limited, the holders of all the second debenture stock of the Company, whereby they consent to the total amount of second debenture stock being increased from £100,000, the present amount, to £150,000; thus leaving £50,000 at the disposal of the Board.

YEADON LOCAL BOARD AND THE WATER COMPANY'S BILL.—A special meeting of the newly-elected Local Board for Yeadon was held last Wednesday, when the Chairman (Mr. Yeadon) stated that, knowing that the time for taking action against the Bill promoted by the Yeadon Water Company in the present session of Parliament was nearly expiring, he had taken upon himself the responsibility of directing the Clerk to give instructions for Counsel to appear before the Committee of the House of Commons when the Bill came before them, and ask that its consideration be postponed until the Local Board could meet and discuss the matter. The Bill was before the Committee on the previous Monday; and on the application of Counsel, the consideration of the Bill had been adjourned. A motion was passed to the effect that the Board approved the action taken by Mr. Yeadon. Mr. Biltcliffe proposed, and Mr. Flaxington seconded, the following motion:—"That this Board take steps to obtain power to oppose the Bill of the Yeadon Water Company; and if such permission be granted, to take such steps as may be necessary to oppose the same." This motion occasioned a long discussion; but in the end it was passed.

GWYNNE & CO., ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS & ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 2698.

Exhausters of nearly all sizes in Stock.

Prize Medals at all the Great International Exhibitions.

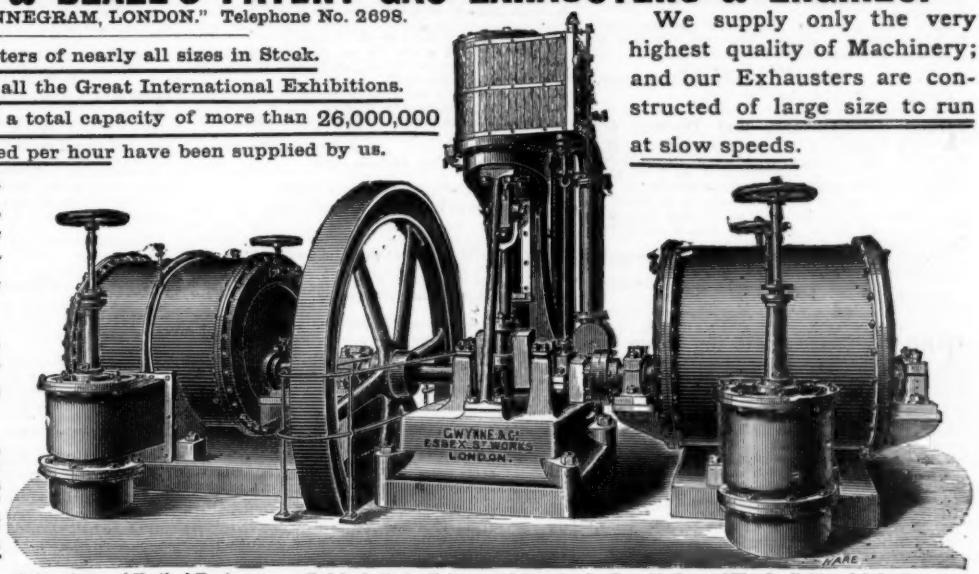
Exhausters equal to a total capacity of more than 26,000,000 cubic feet passed per hour have been supplied by us.

Our new Patent Non-Fluctuating Exhausters, to work without the slightest oscillation or variation in pressure, are strongly recommended.

MAKERS OF EVERY DESCRIPTION OF HYDRAULIC AND GAS MACHINERY.

Gwynne & Co.'s New Catalogue and List of Testimonials can now be obtained on application.

We supply only the very highest quality of Machinery; and our Exhausters are constructed of large size to run at slow speeds.



Exhausters and Vertical Engine as supplied for both the Fulham and Bromley-by-Bow Stations of The Gaslight and Coke Company

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

ANDREW STEPHENSON, Agent for the GAS PURIFICATION AND CHEMICAL COMPANY, Limited, Palmerston Buildings, Old Broad Street, LONDON, E.C.

CANNEL COAL, &c.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 30, ST. ANDREW SQUARE, EDINBURGH, / No. 54, BERNARD STREET, LEITH, } SCOTLAND.

SHIPPING AND INSURANCE.

ROBERT BRUCE FITZMAURICE, 9, Crosby Square, London, E.C., Shipping Agent to several Foreign Gas Companies, is prepared to attend to the Forwarding and Insurance of Goods for Foreign and Colonial Gas Companies, &c., and Gas Plant Manufacturers.
For Rates of Freight, apply as above.

ADVERTISEMENT NO. 1697.

A NUMBER of applications have been received in reply to this Advertisement last week for a Gas Manager; and the Secretary begs to state that the most eligible Candidates will be communicated with in a few Days. Thanks for replies.

WANTED, by a Coal Factor, Travellers for Southern and Eastern Counties. Must have connection with Gas Companies. State if know any other ground in addition.
Apply, by letter only, to No. 1694, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Re-engagement as WORKING MANAGER, where the make is from 8 to 10 millions per Annum. Understands the Manufacture and Distribution of Gas by all the latest Improvements. In present situation over 20 years. Good character.
Address No. 1700, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TIMMIS & CO., of STOURBRIDGE
Make only the best quality of FIRE-CLAY RETORTS, BRICKS, TILES, & LUMPS. Also SPECIAL SILICA BRICKS, to stand great heats.
All descriptions kept in Stock.
For Prices apply to JAMES LAWRIE AND CO, 1, Whittington Avenue, Leadenhall Street, E.C., Sole Agents for London and District.
Telegraphic Address: "EIRWAL, LONDON."

ALEX. WRIGHT & Co., 55, 55a, and 56, MILLBANK STREET, LONDON, S.W.
[Telegraphic Address: "PRECISION LONDON."]
Makers of Wet and Dry Gas-Meters, Station Meters and Governors, Photometers, and Gas-Testing Apparatus, Test Gasholders and Meters, Registering and other Gauges, &c., &c.
. See Advertisement on Page III. of the Wrapper of this week's issue.

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
. See Advertisement p. 743 of last week's issue.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for Wet and Dry Gas-Meters, Station Meters, and Governors, Pressure-Gauges, Street Lamps, and Pillars, &c.
Telegraphic Address: "Braddock, Oldham."

FORCED DRAUGHT.

MELDRUM BROS., Engineers, of 26, Half Street, Cathedral Yard, Manchester, are prepared to Supply and Fix to any ordinary Boiler Furnace complete APPARATUS for burning Breeze, Coal Dust, or other small or poor Fuel. Results guaranteed. Terms on application.

WANTED, a Working Manager to take charge of the Holyhead Gas-Works, North Wales. Wages 35s. per week, with House, Gas, Coal, and Water found.
Applications, stating age and experience (enclosing testimonials), to be sent, on or before Wednesday, the 1st day of May, to Mr. HUGH WILLIAMS, Admiralty House, HOLYHEAD.

WANTED, Second-hand Gasholder TANK-PLATES.
Apply, stating sizes and thicknesses of plates, price, and where to be seen, to JAMES ROSS AND CO., Lime Wharf Chemical Works, FALKIRK.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application. Spent Oxide and Sulphate of Ammonia purchased.
120 and 121, NEWGATE STREET, LONDON, E.C.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID for making SULPHATE OF AMMONIA of high quality and colour.
Highest References and all particulars supplied on application.

SULPHATE of Ammonia Lead Work and Fittings. Lead Burner. Tanks and Saturators made and repaired on the shortest notice.
Address P. J. DAVIES, 78, Earl's Court Road, Kensington, LONDON.

WASHER.

WANTED, a Small Washer (Second-hand) for Works carbonizing about 100 tons of Coal per annum.
Address C. W. GRIMWOOD, Sudbury, SUFFOLK.

WANTED, back Volumes of the "JOURNAL OF GAS LIGHTING," bound or unbound. State price and particulars.
Address No. 1699, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED—Any Gas Company having for Sale one LIVESEY WASHER, and one KIRKHAM'S SCRUBBER for 500,000 feet per day, will please communicate with Mr. LONGWORTH, Gas Offices, GUILDFORD.

FOR SALE, Cheap—Four Purifiers in a group 16 ft. by 12 ft. by 8 ft. 9 in. deep, with Centre-Valves and Connections (12-inch) complete. Practically equal to new.
Apply to SAMUEL WHILE, 60, Queen Victoria Street, LONDON, E.C.

FOR SALE—By the Clayton, Allerton, and Thornton Gas Company, Two 12-inch ANDERSON'S PATENT CONCENTRIC STATION GOVERNORS, in good working condition. Being taken out to replace them with larger Governors. One is taken out, and the other will be at liberty in June. No reasonable offer refused.
Apply to the undersigned.
JOHN NIVEN,
Engineer and Manager.
Clayton, near Bradford,
April 3, 1889.

THE Tenterden Gas Company are prepared to receive TENDERS for 400 tons of best GAS COAL, to be conveyed to Appledore Station.

Tenders to be sent to Mr. Cooper on or before the 7th day of May, 1889.

TO COAL MERCHANTS, SHIP-OWNERS, AND OTHERS.

THE Directors of the Torquay Gas Company are prepared to receive TENDERS for the supply for One, Two, or Three years of about 10,000 tons per year (or such other quantity as may be agreed on) of approved GAS COALS.

For particulars apply to Mr. Beynon, the Manager of the Company, Hollacombe, Paignton.

Tenders to be sent to the undersigned on or before the 24th day of April inst.

By order,
J. KITSON, Secretary.

Torquay, April 8, 1889.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO TAR DISTILLERS.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for the purchase of the surplus TAR now in stock and to be produced at their Works in Radcliffe during the ensuing year.

Particulars may be obtained from the undersigned, to whom endorsed tenders must be delivered not later than Thursday, the 2nd of May next.

JAMES BRADDOCK,
Manager and Secretary.

Gas-Works, Radcliffe, April 16, 1889.

THE Colwyn Bay and District Gas and Lighting Company, Limited, invite TENDERS for the enlargement of their Works at Colwyn Bay, consisting of a GASHOLDER, to hold about 30,000 cubic feet, additional PURIFIERS, &c.

Plans and specifications can be seen at the Company's Office, in the Public Hall, Colwyn Bay, from Monday, April 29, to Saturday, May 4 (inclusive), between the hours of Eleven and One.

The Company do not bind themselves to accept the lowest or any tender.

T. J. LINEKAR, Secretary.

April 17, 1889.

CORPORATION OF CARNARVON.

THE Gas Committee of the above Corporation invite TENDERS for the supply of about 1500 tons of COAL and 500 tons of CANNEL or CANNEL NUTS per Annum, for One, Two, or Three years.

Sealed tenders, endorsed "Tender for Coal," or "Tender for Cannel," and addressed to the Chairman of the Gas Committee, Gas Office, Carnarvon, to be sent not later than the 30th of April inst.

The Gas Committee do not bind themselves to accept the lowest or any other tender.

Further particulars on application to

MAT. J. PARSONS,
Engineer and Manager.

Gas Office, Guildhall, Carnarvon,
April 18, 1889.

CORPORATION OF LEICESTER.

COAL TENDERS.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of COALS, COBBLES, or NUTS (about 95,000 tons per annum), for One, Two, or Three years, ending May 31.

Particulars and form of tender can be obtained on application to the Engineer.

Tenders, addressed to Councillor Lennard, Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, May 11 prox.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, C.E.,
Engineer and Manager.

Gas Offices, Millstone Lane, Leicester,
April 11, 1889.

SUTTON-IN-ASHFIELD LOCAL BOARD.
(GAS DEPARTMENT.)

TO TAR DISTILLERS AND OTHERS.

THE Gas Committee of the Sutton-in-Ashfield Local Board are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during the ensuing year.

Particulars may be obtained on application to the Manager, at the Gas-Works, Sutton-in-Ashfield, Notts.

Tenders, stating price per ton of 20 cwt. at the Works, to be addressed to "The Clerk to the Local Board, Local Board Offices, Sutton-in-Ashfield," and marked "Tender for Tar and Liquor," so as to arrive not later than Tuesday, the 30th of April, 1889.

By order,
G. H. HIBBERT,
Clerk to the Committee.

Local Board Office, Sutton-in-Ashfield, Notts.

SUTTON-IN-ASHFIELD LOCAL BOARD.
(GAS DEPARTMENT.)

SUPPLY OF GAS COAL.

THE Gas Committee of the above Local Board are prepared to receive TENDERS for the supply of 2200 tons of well-screened GAS COAL and 250 tons of CANNEL, to be free from Shale and Pyrites, and to be delivered at the Railway Station, Sutton, in such quantities as the Manager shall from time to time direct, between July 1, 1889, and June 30, 1890.

Particulars may be obtained on application to the Manager, at the Gas-Works, Sutton-in-Ashfield, Notts.

Tenders, stating price, to be addressed as above, and marked "Tender for Coal," so as to arrive not later than Tuesday, the 30th of April, 1889.

By order,
G. H. HIBBERT,
Clerk to the Committee.

Local Board Offices, Sutton-in-Ashfield, Notts.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Directors of the Wellington (Salop) Coal and Gaslight Company invite TENDERS for the purchase of the surplus TAR to be produced at their Works for One year, from the 1st of June next.

Particulars may be obtained from the undersigned, to whom tenders should be sent on or before May 10.

JNO. C. BELTON, Manager.

Wellington, Salop, April 12, 1889.

THE Directors of the Sutton, Southcoates, and Drypool Gas Company, Hull, invite TENDERS for EXCAVATING TRENCH for, and LAYING of 607 yards of 18-inch, 483 yards of 16-inch, and 500 yards of 12-inch MAINS (Labour only).

For further particulars apply to the Manager at the Works.

Tenders to be sent in on or before Monday, the 6th day of May, 1889.

DAVID WOOD, Secretary.

Offices: St. Mark's Street, Hull, April 18, 1889.

TENDERS FOR COALS.

THE Directors of the Town of Dudley Gaslight Company are prepared to receive TENDERS for the supply of 10,000 tons of GAS COALS, to be delivered at the London and North-Western Railway or Great Western Railway Sidings, Dudley, in such quantities as may be required from the 1st of July, 1889, to the 30th of June, 1890.

Sealed tenders, addressed to the Chairman, and endorsed "Tender for Coals," to be sent in not later than the 14th of May next.

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to divide the contract between two or more firms.

By order,
T. E. STILLARD, Secretary.

Gas-Works, Dudley, April 17, 1889.

BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS (from Colliery Proprietors only) for the supply of 45,000 tons of GAS COAL, and 10,000 tons of CANNEL, to be supplied in such quantities as may from time to time be determined by the Gas-Works Committee during the year ending the 30th of June, 1890.

Forms of tender and further information may be obtained on application to Mr. Thomas Holgate, Manager, Gas-Works, Halifax.

Tenders, endorsed "Tender for Coal," must be sent to me on or before the 9th of May, 1889.

By order,
KEIGHLEY WALTON, Town Clerk.

Town Hall, Halifax, April 20, 1889.

TO MANUFACTURING CHEMISTS.

TAR AND AMMONIA WATER.

THE Directors of the Loughborough Gas Company are prepared to receive TENDERS for the surplus TAR and AMMONIA WATER to be produced at their Works between the 30th of June, 1889, and the 30th of June, 1890.

The estimated quantities will be about 300 tons of Tar, and 600 tons of Ammonia Water. The Tar and Liquor to be delivered into the Contractor's Boats at the Wharf on the Derby Road, Loughborough.

The strength of the liquor to be tested by Twaddell's hydrometer; and the tender to state the price per ton to be paid for every 1° of strength from 4°. The boats for the removal of the Tar and Liquor to be sent at such times as may be required.

Payments monthly.

Further information may be obtained on application to the undersigned, to whom tenders, in accordance with this advertisement, must be sent not later than the 30th of the present month.

The Directors do not bind themselves to accept the highest or any tender.

J. B. BALL, C.E., Manager.

April 15, 1889.

CORPORATION OF NOTTINGHAM.
(GAS DEPARTMENT.)

TENDERS FOR COALS.

THE Gas Committee are desirous to receive OFFERS for supplies of COALS, COBBLES, or NUTS for the period terminating the 30th of June, 1890.

The large Coals and the Cobbles or Nuts are to be separately delivered, where and as from time to time directed, by and at the expense of the Contractors, upon the Gas-Works Siding, Great Northern Railway, in the East Croft, at Nottingham, and also on the Gas-Works Sidings, Midland Railway, at Radford and Basford respectively; and at and after the rate of one-eighth part of such total quantity in each calendar month, commencing with the month of July next, till the Corporation shall be satisfied with the amount of accumulated stock, and afterwards at such rate as shall be from time to time directed, till the agreed quantity shall have been delivered.

The Coals, Cobbles, or Nuts are to be the best of their respective kinds, well screened (description, sizes, and inclination of screen to be specified), to be as free as possible from sulphur, bats, bind, refuse, and dirt, and shall be weighed (20 cwt. to the ton) upon the Corporation machines, or upon such other machines as may be mutually agreed upon.

Payments will be made monthly, if and so long as the contract shall be duly fulfilled.

The Corporation do not bind themselves to accept the lowest or any tender.

Further information and forms on which the tenders must be made may be obtained on application to me, at the General Manager's Office; and the tenders (sealed) specifying the description of Coals and the pits at which they are to be raised, and stating the prices for deliveries at the several places and in manner and subject to the conditions aforesaid, must be delivered to Samuel George Johnson, Esq., Town Clerk, on or before Tuesday, the 7th day of May, 1889.

By order,
WILLIAM R. CHESTER,
Engineer and General Manager.

Corporation Gas Offices, George Street,
Nottingham, April 17, 1889.

COUNTY BOROUGH OF SALFORD.

THE Gas Committee are prepared to receive TENDERS for the supply of the RETORT-FITTINGS required for Retorts at the Regent Road Works.

The plans and specifications may be seen, and all particulars obtained, on application to the Engineer, Gas Offices, Salford.

Sealed tenders, endorsed "Tenders for Retort Fittings," addressed to the Chairman of the Gas Committee, must be delivered at my Office before Five p.m. on Thursday, the 2nd of May, 1889.

By order,
SAML. BROWN, Town Clerk.

Town Hall, Salford, April 13, 1889.

TENDERS FOR COAL.

THE Corporation of Droitwich invite TENDERS for the supply of from 500 to 800 tons of best screened GAS COAL, at per ton of 21 cwt., to be delivered free at Droitwich (G.W.) Railway Station, or, if by Water, on the Wharf at the Droitwich Gas-Works, at such times and in such quantities as may be required.

The contract will be for one year, commencing o the 1st prox.

Tenders (with analysis of Coal proposed to be supplied), properly endorsed "Tender for Gas Coal," to be sent to the undersigned on or before the 30th inst.

The Corporation do not bind themselves to accept the lowest or any tender.

S. JOHN TOMBS, Town Clerk.

Droitwich, April 8, 1889.

BOROUGH OF OLDHAM.

THE Gas-Works Committee are prepared to receive TENDERS for supplying the CANNEL and COAL required by them during a period of One, Two, or Three years, commencing from the 1st of July next.

Specification and form of tender can be obtained on application to Mr. Herbert Andrew, Gas and Water Offices, Oldham, to whom tenders are to sent on or before Tuesday, May 7, 1889.

A. NICHOLSON, Town Clerk.

Oldham, April 18, 1889.

BOROUGH OF OLDHAM.

THE Gas-Works Committee invite TENDERS for the TAR and AMMONIACAL LIQUOR to be produced at their different Gas Stations for a period of Two years, commencing the 1st of July next.

The yearly make of Tar is about 6000 tons; and of Ammoniacal Liquor, about 2,400,000 gallons.

Particulars and forms of tender can be obtained on application to Mr. Herbert Andrew, Gas and Water Offices, Oldham, to whom tenders are to be sent on or before Tuesday, the 7th of May, 1889.

A. NICHOLSON, Town Clerk.

Oldham, April 18, 1889.

THE Edinburgh and Leith Corporations Gas Commissioners invite OFFERS for the supply of the following MATERIALS, at their Works in Edinburgh and Leith, during the Twelve Months from and after the 15th of May, 1889:—

RETORTS and FIRE-CLAY MATERIALS.
COAL.
LIME.
CAST-IRON PIPES and CONNECTIONS.
WROUGHT-IRON TUBE and FITTINGS.
METERS (WET and DRY).
GAS-FITTERS' STORES.
IRON, STEEL, and IMPLEMENTS.
YARN, TWINE, HEMP, &c.
IRON CASTINGS.
OILS, PAINTS, &c.
TIMBER.
CARTAGES.
CAUSEWAY REPAIRS.

Tender Forms can be obtained from the Engineers at the respective Works, and must be lodged with the Subscriber not later than Noon on Monday, the 29th inst.

JAMES M'G. JACK, Clerk.

25, Waterloo Place, Edinburgh,
April 15, 1889.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 50,000 tons of best DOUBLE-SCREENED LARGE GAS COALS, the deliveries to commence in July next, for a period of One year, and to be supplied in monthly quantities in accordance with the Specification.

A quantity of about 8000 tons will be required at the Bute Terrace Works, and about 42,000 tons at the Grangetown Works, Cardiff.

Parties tendering can do so for the whole quantity, or for quantities from 5000 tons upwards.

The Company's Grangetown Works are in direct communication with all Railway Companies and with the Penarth Docks, and well situated for receiving cargoes of Coal by steamers.

Deliveries, if by steamer, to be free into trucks at Penarth Docks, and if by rail, free into the Works at Grangetown; those for the Bute Terrace Works to be delivered at the Cardiff Station of the Great Western, Taff Vale, or Rhymney Railway.

Specification of monthly deliveries, conditions of discharging, and all other information required, can be obtained on application to Mr. H. Morley, the Company's Engineer.

The tenders must state the name and locality of the Colliery, also the particular seam from which it is proposed to supply the coal, and the price, delivered as above, accompanied if possible with a practical working analysis.

Sealed tenders to be sent to the undersigned not later than Wednesday, the 1st of May next, addressed to the Chairman of the Company, endorsed "Tender for Coal."

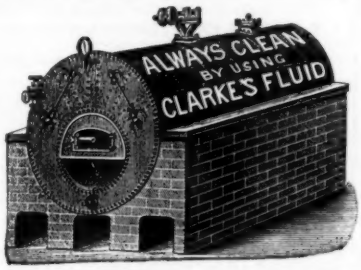
The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY, Secretary.

Gas Offices, Cardiff, March 30, 1889.

TROTTER, HAINES, & CORBETT,
BRETTELLS' ESTATE
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICK,
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAYS.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.



A 10-H.P. BOILER
KEPT PERFECTLY CLEAN FOR
ONE SHILLING PER WEEK
And much smaller Coal Bills. Softens the Hardest Water, and keeps Gauge-Glasses quite clear.

H. CLARKE & Co., Ld., Ipswich.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

THE
LANEMARK COAL Co., LTD.,
Now offer their superior
GAS COALS

LANEMARK CANNEL.
Yield of Gas per ton . . 10,880 cub. ft.
Illuminating Power . . 29·21 candles.
Coke per ton . . . . 1266·96 lbs.

LANEMARK GAS COAL.
Yield of Gas per ton . . 11,379 cub. ft.
Illuminating Power . . 17·88 candles.
Coke per ton . . . . 1285·53 lbs.

LANEMARK GAS BRIQUETTES.
Yield of Gas per ton . . 10,734 cub. ft.
Illuminating Power . . 22·70 candles.
Coke per ton . . . . . 1320 lbs.

For Prices and Analyses, apply to
LANEMARK COAL Co., Ltd.,
NEW CUMNOCK, N.B.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

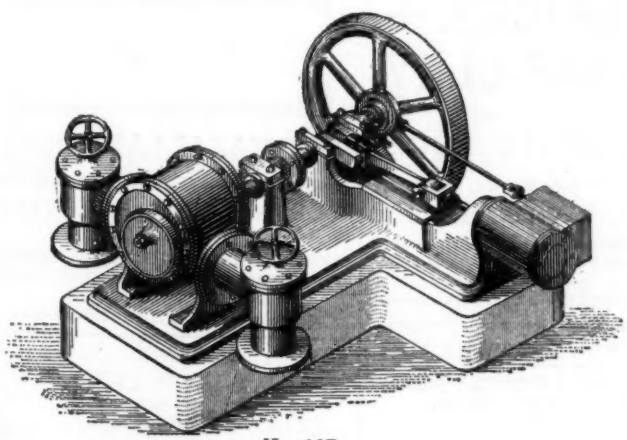
For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
COAL OWNERS, NEWCASTLE-ON-TYNE,
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

G. WALLER & Co.'s NEW PATENT GAS EXHAUSTER.
MADE WITH FOUR OR THREE BLADES.

In use at, or on order for, over 120 *Works, equal to* 6,840,000 *Cubic Feet per Hour.*

Oldest Makers of Beale Exhausters for over 300 Works and 25,600,000 cubic feet per hour.

1,000 to 250,000 CUBIC FEET PER HOUR WITH OR WITHOUT ENGINE COMBINED.



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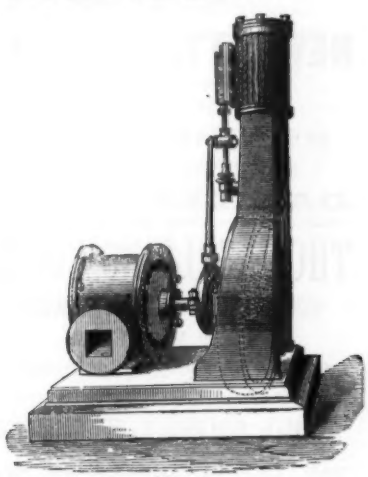

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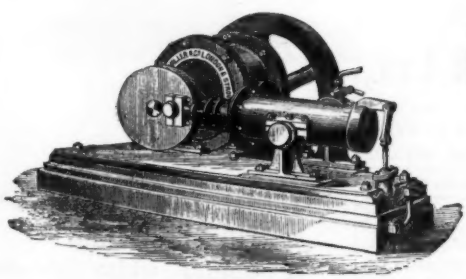

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No. 137.—Horizontal Combined Engine and Exhauster.
No. 6.—Vertical ,, for small space.
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BYE-PASS VALVES.
Disc, Rack, and Screw Valves, Compensating Governors (For Steam Throttle Valves),
Tar, Liquor, and Water Pumps, Hydraulic Main Valves, Coke-Breaking Machines.

SEE PREVIOUS ADVERTISEMENTS. ILLUSTRATED CATALOGUE ON APPLICATION.

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NEAR SOUTHWARK BRIDGE (FOUR MINUTES FROM HOLLAND STREET), AND AT
STROUD, GLOUCESTERSHIRE.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Invention may be secured for Twelve months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

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AT THE
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DESIGNED AND CARRIED OUT BY
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Engineer of the Works.
London: WALTER KING, 11, Bolt Court, FLEET ST., E.C.

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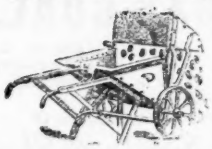

effecting a great saving of time, labour, and expense.
For particulars, price &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.
Prices are Reduced

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(Established 1820)
FIRE-BRICK AND TILE MERCHANTS,
Wholesale and for Exportation,
FALCON DOCK, 78 AND 79, BANKSIDE,
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DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES and FIRE-CLAY, and every Article suitable for
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NEWBATTLE CANNEL.
QUOTATIONS ON APPLICATION TO
MR. JOHN MORISON,
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THOMAS ILLINGWORTH,
NORTH DEAN CHEMICAL WORKS,
Near HALIFAX,
MANUFACTURER OF SULPHURIC ACID
OF EXTRA QUALITY FOR MAKING
WHITE SULPHATE OF AMMONIA.
TAR, LIQUOR, AND SPENT OXIDE
Purchased for Cash against Delivery.

THOMAS TURTON AND SONS, LIMITED,
SHEAF AND SPRING WORKS
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MANUFACTURERS OF
FILES OF BEST QUALITY FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNER RATCHET BRACES, LIFTING-JACKS, ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
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W. G. WALLER & Co.,
RETORT SETTERS & CONTRACTORS,
Having had much experience in the Setting of Retorts, beg to call the attention of Gas Engineers and Managers to their Improved System of Setting Retorts and Tar-Furnaces.
Contractors for Building Shafts, Tanks, Retort Benches, and all other Buildings connected with Gas-Works.
Estimates on application.
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JAMES OAKES & CO.,
ALFRETON IRON-WORKS, DERBYSHIRE,
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WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter; and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers and rendering leakage impossible.

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VALVES
FOR GAS, WATER, AND STEAM.
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Sole Proprietors of the Largest and Purest Beds of Fire-Clay in England.
FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the market.
GANNISTER and SILICA FIRE-CLAY guaranteed of the Purest and Finest Quality.
ANALYSIS AND REFERENCES ON APPLICATION.

GAS COAL.
POPE & PEARSON, LTD.,
have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields in practical working over 10,000 cubic feet of gas, with an illuminating power of 16 candles; or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.
One ton yields 12¼ cwt. of good coke.
This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.
For further particulars apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

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FOR GAS, ETC., PREPARED BY
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Estimation of (1) Moisture, 1s.; (2) Volatile Matter, 1s. (3) Coke, 1s.; (4) Permanent Gases, 2s. 6d.; (5) Ash, 1s. (6) Ammonia Capacity, 2s.; (7) Carbon, 1s. 6d.; (8) Sulphur, 2s. 6d. 1, 2, and 3 = 2s. 6d.; 1, 3, and 4 = 4s.
Complete Combustion, 10s. 6d.
Five Samples submitted at same time to secure above Rate.
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Gas Companies are solicited to try Samples of the
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Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
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THE ONLY RELIABLE
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WORKING ONE, TWO, THREE, OR FOUR PURIFIERS ON AT THE TIME.
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No Springing. No Leakage. No Foul Gas passed in Changing. Special Facility for Blowing the Air out of the Fresh Box before putting in Action, without driving it forward into the Holders.
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CHANDLER'S PATENT.
SUITABLE FOR EVERY FORM OF LIGHTING.
A beautiful white light from ordinary Gas. Silent, steady, and economical.
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JOHN RUSCOE calls attention to his Retort Mouthpiece and Lid Facing Machines, which are in extensive use; also to his Lathes, Drilling, Slotting, Grooving, and Planing Machines, Smiths' Hearths, Smithy Fans, Roots' Blowers; also special Screwing Machines for Gas Tubes and Bolts, Taps, Wrenches, Pipe Cutters, special Taper and Twisted Rymers, Drills, &c.

PATENT TWISTED TAPS, DIES, & CUTTERS.

Thousands in constant work, give universal satisfaction.

Work Easier, Less Friction, Last Longer, and do Better Work than straight Grooves.

Main Drilling Stand, with Cup Drills, 1¼ to 6 inch; Taps, Rymers, and Drills.

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BELL'S ASBESTOLINE.

All kegs are labelled as above.

REGISTERED.

ADVANTAGES OF ASBESTOLINE.

ASBESTOLINE is the most efficient Lubricant for all bearings.
ASBESTOLINE is the cheapest Lubricant.
ASBESTOLINE saves from 50 to 90 per cent. of the Cost of Oil.
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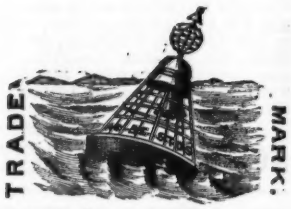
ASBESTOLINE is the safest Lubricant from Ignition.
ASBESTOLINE has beaten all other Lubricants in trials.
ASBESTOLINE is applicable in and out doors in every Climate.
ASBESTOLINE requires no special application.



CONSISTENCY OF ASBESTOLINE.

ASBESTOLINE, to meet all circumstances, is made in four degrees of consistency—A, B, C, and CC.

ASBESTOLINE, A, is specially adapted to ordinary Land Engines and Machinery, in and out door, in this country.

ASBESTOLINE, B, a little more solid, is for use on Steamships in temperate climates, also on land when it is desirable to have Lubricant stiffer than A.

ASBESTOLINE, C, is for use in tropical climates, both ashore and afloat. It is also invaluable in works in this country when the temperature is high.

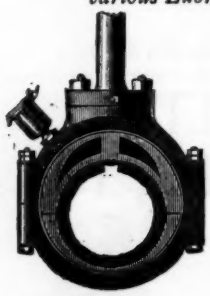
ASBESTOLINE, CC, is designed for use on Calenders, Paper-Machines, &c., where the bearings are heated by steam passing through, and sometimes is advantageously used instead of C.

The reputation of Asbestoline as a Lubricant of the highest efficiency in every kind of Machinery is established; and it has never been equalled by any other Lubricant in the numerous cases of special difficulty in which the best oils are ineffectual. It is used with marked success in Steel and Iron Works, Collieries, Cotton and Wool Mills, and other Textile Manufactories. In Corn-Mills it has proved invaluable on the roller and other modern machines. In Saw-Mills, on machines going up to 5000 revolutions per minute, its work has never been approached by any other Lubricant. On Electric Lighting Machinery, and in Steamships of all sizes throughout the world, the success of Asbestoline is unequalled. Many engines and machines of all descriptions give trouble, and show bad results both in working and wear, when the system of lubrication has not received due consideration. Engineering firms of the highest standing have given to it their powerful testimony and support.

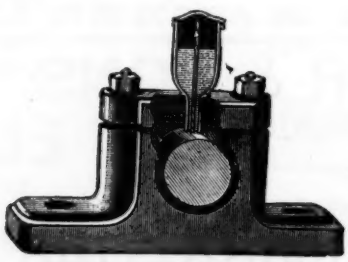
Supplied in Kegs, 28, 56, or 112 lb. Price, 2/3 per lb. Kegs Free. Special Terms for Large Quantities.

IMPORTANT TO EXPORT MERCHANTS.—*One pound of "Asbestoline" equals 2 gallons of Oil weighing 18lbs.; consequently the saving in freight is very considerable. Liberal Terms are conceded to Export Merchants.*

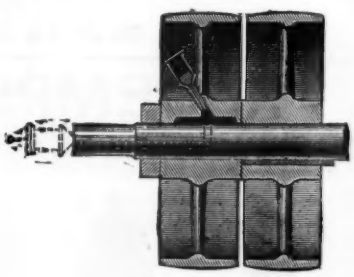
Below will be found illustrations of the mode of fixing Lubricators for Asbestoline to bearings. Full particulars of the various Lubricators supplied for Asbestoline, and the manner of fitting, in catalogue free on application.



Lubricator fitted to Eccentric of Vertical Engine



Showing Section of Lubricator fitted to ordinary Bearings.



Lubricator in different position for Loose Pulleys.

THE ATTENTION OF

ENGINEERS, AND ALL USERS OF STEAM POWER AND MACHINERY,

IS SPECIALLY INVITED TO THE FOLLOWING REPORT.

Owing to the number of Greases now offered, samples of BELL'S ASBESTOLINE were submitted to Otto Hehner, Esq., for analysis, and the subjoined Report fully proves BELL'S ASBESTOLINE to be the safest as well as the best Lubricant for all purposes:—

The Laboratory, 11, *Billiter Square, E.C., London, May* 3, 1888.

I have subjected a sample of Bell's Asbestoline taken from the stores of Messrs. J. Bell and Son, in Southwark Street, to a number of tests, in order to ascertain whether its use in Mills or Factories might contribute to the danger from Fire.

I found that Asbestoline **ignites only with the greatest difficulty** when brought into contact with flame; that wood and other combustible material soaked in Asbestoline burns, if anything, with greater difficulty than by itself; that its **flashing point** is so high that it lies **beyond the range of Mercurial Thermometers**; and that consequently no friction obtainable in the ordinary run of machinery is capable of developing inflammable vapours from it.

Bell's Asbestoline is **as absolutely safe a Lubricant as can be desired or obtainable.** In the case of fire breaking out from any cause, it does not assist the conflagration; and it is **quite incapable of leading to spontaneous combustion,** either by itself or in contact with inflammable material.

From the physical nature of Asbestoline its use is of necessity perfectly clean and free from waste.

(Signed) OTTO HEHNER, Public Analyst.

Illustrated Priced Catalogue, with numerous Testimonials by Leading Firms, free on application.

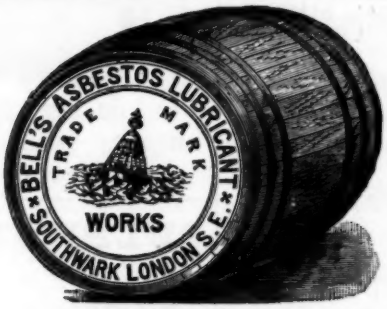
BELL'S ASBESTOS COMPANY, LIMITED,

DEPOTS—MANCHESTER: Victoria Buildings, Deansgate. LIVERPOOL: 2, Strand Street, James Street.

BELL'S ASBESTOS LUBRICANT.

(REGISTERED.)

All Drums marked as above.



Every Cask is sent out as above.

All Corks are sealed as above.

Any Customer receiving Oil sold as **Bell's Asbestos Lubricant**, and Cask, Drum or Corks not marked as above, is earnestly requested to forward us sample and particulars of where obtained.

The following Oils, refined and prepared by our Asbestos process, are specially recommended to Users of Machinery of every kind in all parts of the world. We guarantee the quality of each to be unequalled at the price for the purpose named, and a Sample Drum, containing 5 gallons of each or any sort, will be sent on approval to any respectable firm in any part of the world :—

BELL'S SPECIAL GAS-ENGINE OIL.—This oil is guaranteed to stand flame temperature, and is suitable for light Machinery and Shafting where gas power is used.
Price **2s. 9d.** per gallon.

1a.—BELL'S SPECIALLY PURIFIED DARK CYLINDER AND VALVE OIL.—This oil is guaranteed not to gum, corrode, or in any way injure metal surfaces. It will not carbonize, nor leave any deposit whatever in cylinders or condensers, nor will it injure india-rubber valves. It is absolutely pure hydrocarbon, and will work admirably in all good Sight-feed Lubricators.
Price **3s. 9d.** per gallon.

2a.—Bell's Specially Refined and Purified Pale Cylinder and Valve Oil contains the same properties as 1a, and is one of the very best Oils of the Valvoline class in the market.
Price **4s. 6d.** per gallon.

BELL'S PALE COMPOUND MACHINERY AND ENGINE OIL FOR EXTERNAL LUBRICATION ONLY.

"3c."—For small and medium-sized Engines, Shafting, and quick-running Machinery, displacing Lard Oil. Price **2s. 6d.** per gallon.

"3c. Special."—Heavier bodied than "3c.," and suitable for Locos. and Stationary Engines up to 800-H.P., displacing Olive Oil.
Price **2s. 9d.** per gallon.

"3c. Marine."—Much heavier than "3c.;" suitable for Marine Engines and heaviest Stationary Engines, Shafting, &c., displacing Castor Oil. Price **3s.** per gallon.

BELL'S AGRICULTURAL MACHINE OIL, for Traction Engines, Road Rollers, and all Machines working out of doors. This Oil will not set on bright parts, is not affected by extreme cold or the rays of the sun. Price **2s. 9d.** per gallon.

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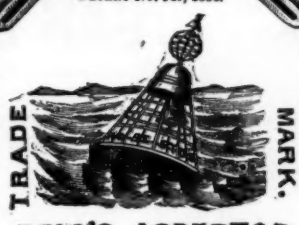
The above, which can only be obtained from this house, is recognized as the Most Efficient and Economical Jointing Material in use. It is composed of a specially prepared India-rubber Compound, protected by a covering of Vulcanized Asbestos Sheeting, as shown above, and as it is the only Jointing Material which adequately combines PERMANENT ELASTICITY WITH HEAT RESISTANCE, the advantage it possesses will at once be seen.

SECTION OF SHEETING.

PATENT No. 640, 1884.



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The centre from which the requisite elasticity is obtained will adapt itself to uneven surfaces to which it may be applied, and allow expansion and contraction to be fully taken up. The covering, being of Asbestos Cloth, imparts a protection to the centre, and so prolongs its elasticity. For Manhole, Mudhole, Steam-Pipe, and Mash-Tun Door Joints it is unequalled; and if applied as directed, a ring can be used many times over.

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Made from 1-Ply for Cylinder and Faced Joints to any thickness for Uneven Surfaces.

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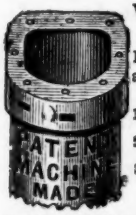

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Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

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2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

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F. & C. OSLER,

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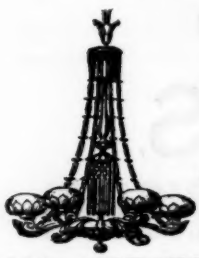

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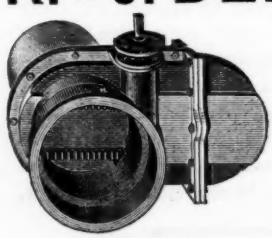

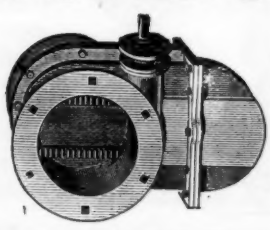

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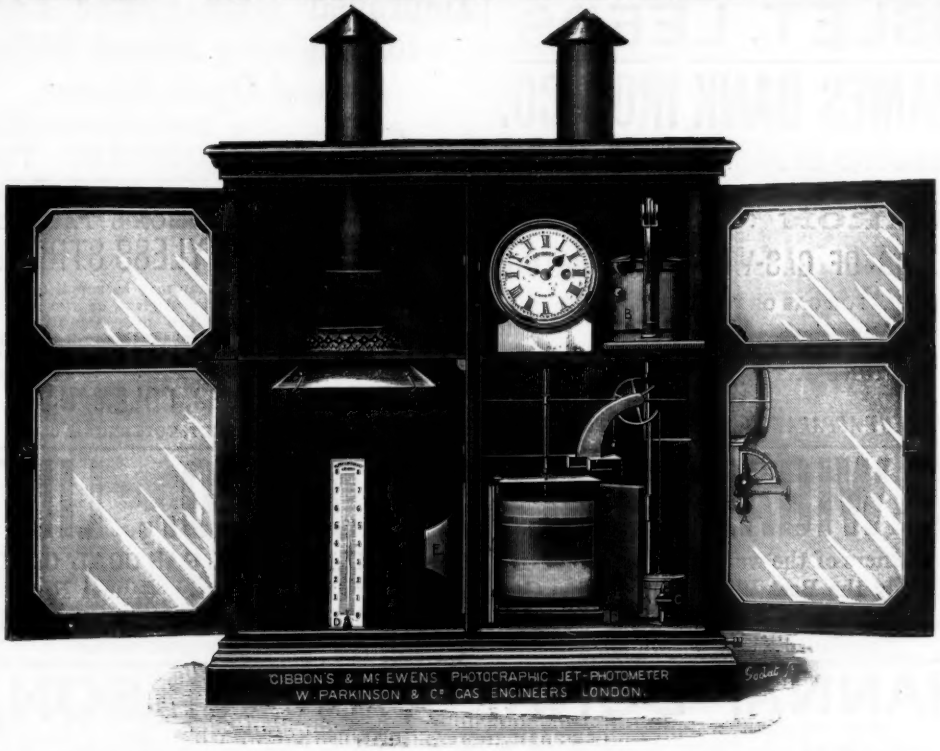

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[See also Advt., p. 752.

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